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Sentinels of The Sea

Lighthouse. From an Old Woodcut.

THE YOUNG LEARNERS LIBRARY

Sentinels of The Sea

By
FRANCIS C. OWEN

Dansville, New York
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FOREWORD

Patriotism and loyalty have their foundation in respect and confidence.

If our young people are to be intelligently loyal to our government, as every citizen should be, it is necessary for them to know what the government stands for; what it is doing for its citizens.

The object of this volume is to set forth as simply and plainly as possible one phase of government service which is not often mentioned in newspapers—that of its assistance to navigation.

In discussing the subject, technical details have been avoided, but it is hoped that enough has been told to give a comprehensive idea of the subject. The author's purpose will have been accomplished if, as a result of reading this book, the boys and girls of our great land understand and more fully appreciate the government under which it is our privilege to live.

It is also hoped that the reading of this volume will lead to a desire to read more about ships and navigation and about the lands to which ships sail after departing from our shores. The public libraries of our country abound in books of travel and adventure which are as thrilling and interesting as any work of fiction, and also very instructive. The reading of such books gives one a fund of general information not obtainable in any other way.

Reports of the Lighthouse Service, Coast Guard, Coast and Geodetic Survey, Weather Bureau, and Department of Commerce have been freely consulted in the preparation of this volume. The illustrations were made from excellent photographs kindly furnished by these government bureaus.

We are also indebted, for valuable information, to "Lighthouses and Lightships of the United States" by George R. Putnam, published by Houghton Mifflin Company.

F. C. O.

SENTINELS OF THE SEA

NAVIGATION

THE SEA

Roll on, thou deep and dark blue ocean,—roll!
Ten thousand fleets sweep over thee in vain;
Man marks the earth with ruin,—his control
Stops with the shore;—upon the watery plain
The wrecks are all thy deed, nor doth remain
A shadow of man's ravage, save his own,
When, for a moment, like a drop of rain,
He sinks into thy depths with bubbling groan,
Without a grave, unknelled, uncoffined, and unknown.

* * * * * *

His steps are not upon thy paths,—thy fields
Are not a spoil for him,—thou dost arise
And shake him from thee; the vile strength he wields
For earth's destruction thou dost all despise,
Spurning him from thy bosom to the skies,
And send'st him, shivering in thy playful spray
And howling, to his gods, where haply lies
His petty hope in some near port or bay,
And dashest him again to earth:—there let him lay.

The armaments which thunderstrike the walls
Of rock-built cities, bidding nations quake
And monarchs tremble in their capitals,
The oak leviathans, whose huge ribs make

Their clay creator the vain title take
Of lord of thee and arbiter of war,—
These are thy toys, and, as the snowy flake,
They melt into thy yeast of waves, which mar
Alike the Armada's pride or spoils of Trafalgar.

* * * * * *

Thou glorious mirror, where the Almighty's form
Glasses itself in tempests; in all time,
Calm or convulsed,—in breeze, or gale, or storm,
Icing the pole, or in the torrid clime
Dark-heaving; boundless, endless, and sublime,
The image of Eternity,—the throne
Of the Invisible! even from out thy slime
The monsters of the deep are made; each zone
Obeys thee; thou goest forth, dread, fathomless, alone.

Lord Byron.

As old as the human race itself, is the problem of navigating the "waters that cover the earth," and it is sad to realize that the difficulties will never be wholly overcome. Hardly a month passes, especially during the fall and winter, that serious marine disasters do not occur, with great loss of life and property.

From the beginning of navigation by the primitive races in their bark canoes, and dug-outs made from the trunks of trees, to the present great ocean liners, there has been constant progress. In ancient days, ships equipped with many oars to be pulled by galley slaves were used for both commerce and war.

Later, sailing vessels were in common use and great fleets of them sailed the "seven seas," some being rigged with as many as six masts and carrying

great cargoes. These were the vessels which carried the commerce of the world until the invention of the steam engine made possible the great steamboats which rapidly came into use.

It was the sailing vessel which inspired Longfellow to write that beautiful poem, "The Building of the Ship," the first lines of which are:

> "Build me straight, O worthy Master!
> Staunch and strong, a goodly vessel,
> That shall laugh at all disaster,
> And with wave and whirlwind wrestle!"

When Columbus discovered America, when the *Mayflower* landed her precious cargo on the bleak New England shore, when Henry Hudson sailed into New York Bay, there were no welcoming beacons to guide the ships into safe harbors or to warn them of dangerous rocks or shoals. For more than two hundred years the commerce of the new country was carried on without such aids to navigation.

The navigator was obliged to exercise great caution in approaching land, and to make frequent soundings to discover the depth of the water and the character of the sea bottom. It was, therefore, very dangerous to the ship, passengers and cargo to enter harbors and make landings.

For many years the need of proper lights and signals was keenly felt, but sailors grew old in the service and their children and grandchildren had taken their places before the first beacon was lighted on the American continent.

To realize the great importance of proper aids to

navigation at the present time, it is only necessary for us to consider that there are about 33,000 vessels of all nations upon the seas.

There were 7454 steam and 7730 sailing vessels flying the flag of the United States of America in 1925 as well as 11,183 propelled by gasoline engines. The total carrying capacity (gross tonnage) of these vessels was over 20,000,000 tons of 100 cubic feet each. This applies to the closed-in spaces and not to their cargo.

Navassa Island Lighthouse
West Indies

The net tonnage of a vessel refers to its cargo carrying capacity.

The displacement of a vessel is its weight in long tons, including its cargo. The displacement of the *Leviathan,* one of the largest passenger vessels afloat, is a trifle less than 60,000 tons.

A vessel ton is equal to 100 cubic feet. In America and Great Britian the long ton of 2240 pounds is employed in computing cargo, while France and other countries having the metric system use 2204 pounds as the weight ton. The "measurement ton" used in computing a ship's cargo, consists of 40 cubic feet.

THE SEA

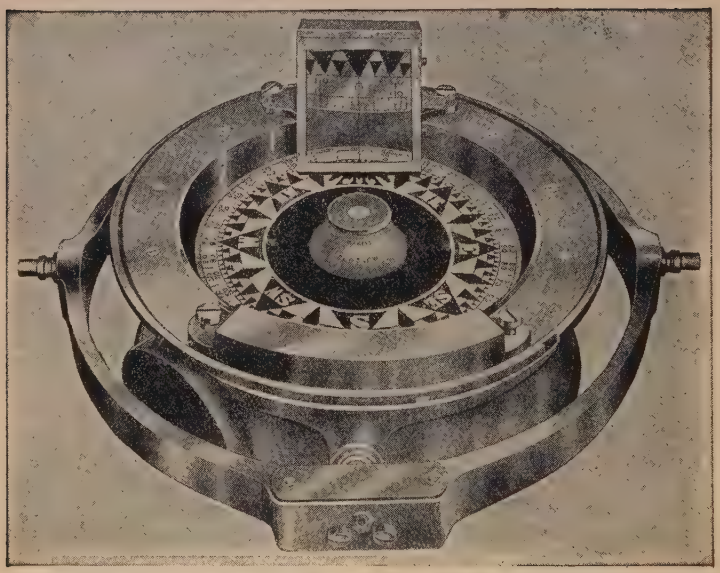
The sea! the sea! the open sea!
The blue, the fresh, the ever free!
Without a mark, without a bound,
It runneth the earth's wide regions round.
Barry Cornwall.

Navigation is an art beset with many dangers and calling for great caution and judgment on the part of navigating officers.

In times past, when ships were small and could sail in shallow water, they were not affected by some of the hazards with which the present large ships have to contend. They could sail near to the land without so much risk of striking hidden rocks or "grounding" on shoals. They were, therefore, able safely to enter harbors where it has been necessary to dredge channels for modern ships. Upon the high seas, however, the problems of to-day are about the same as those which confronted Columbus; those of steering a right course and protecting vessels from danger.

The Compass

Probably the greatest help to navigation was the invention of the compass. This instrument is thought to have originated with the Chinese about 2000 B. C. It is known to have been used along the Syrian coast as early as 1242 A. D. Marco Polo, the great Italian traveler, brought news of the compass upon his return from China about the year 1260, and it is supposed that the Italians improved the instrument.



By Courtesy of Compton's Pictured Encyclopedia

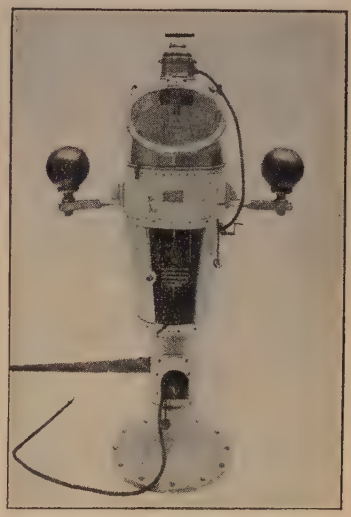
THE LATEST STYLE OF MAGNETIC COMPASS

Here is the modern instrument that guides our mighty ocean liners. An ingenious reflecting device enlarges the guiding marks, enabling the helmsman to steer with greater accuracy.

The compass has a dial consisting of a circular card of mica marked with a star of thirty-two points which are called the "points of the compass." The main or "cardinal" points are North, East, South and West. The spaces between them are divided into half points, quarter points, eighth points and degrees. Naming the points of the compass is termed "boxing the compass."

The compass is provided with a magnetized steel needle mounted on a pivot so that it will turn easily.

Try this interesting experiment. Magnetize an ordinary sewing needle by rubbing it on a magnet. Run the needle through a thin piece of cork and float it on water. The "positive" end will point towards the *magnetic* north pole. Now, the earth is a great magnet, with one pole located far to the north, and to this pole the compass needle is attracted. In theory, the needle points to the magnetic north pole, but on account of other influences, such as large bodies of magnetic iron ore in the earth, it is in some localities deflected from its true position. The compass on shipboard is housed in a case called the binnacle, which is equipped with lights for night use.



Binnacle, U. S. Navy Type

Columbus is generally credited with the discovery that the compass needle does not always point due north. Charts showing the variations of the compass at different points are furnished to the mariner.

The magnetic north pole of the earth is located at latitude 70° north and longitude 96° west, about 20° or 1380 miles south of the *geographic* north pole, which is the one meant when we speak of *the North Pole.* On a certain line passing through central United States and Canada the compass needle points

directly northward. Dallas, Texas, and Winnipeg, Manitoba, are near this line.

At points west of this line the needle is deflected to the eastward, and at points east, to the westward. This deflection increases as the compass is carried northward. When a point exactly west of the magnetic pole is reached, as in northern Alaska, the needle points to the east. At points east of the magnetic pole, as in central Greenland, it points to the west.

As the compass needle points towards the magnetic pole it will be seen that, were the compass to be located at the geographic north pole, the needle would point to the south. Lieut.-Commander Byrd, who passed over the geographic north pole in an aeroplane in 1926, states that the needle of his compass pointed to the south. Navigating officers must, therefore, take their location into account when reading the compass.

A LIFE ON THE OCEAN WAVE

A life on the ocean wave,
  A home on the rolling deep;
Where the scattered waters rave,
  And the winds their revels keep!
Like an eagle caged I pine
  On this dull, unchanging shore:
O, give me the flashing brine,
  The spray and the tempest's roar!

Once more on the deck I stand,
  Of my own swift-gliding craft:
Set sail! farewell to the land;
  The gale follows fair abaft.

We shoot through the sparkling foam,
  Like an ocean-bird set free,—
Like the ocean-bird, our home
  We'll find far out on the sea.

The land is no longer in view,
  The clouds have begun to frown;
But with a stout vessel and crew,
  We'll say, let the storm come down!
And the song of our hearts shall be,
  While the winds and the waters rave,
A home on the rolling sea!
  A life on the ocean wave!

Epes Sargent.

"Locating" Ships

When upon the high seas it is necessary for a mariner, in order to hold to his course, to be able to determine his location. Prior to 1730 the only way this could be done was by keeping account of the distance and direction traveled, using the compass and observing the sun and other heavenly bodies.

The Sextant

In 1730 a sextant was invented by Thomas Godfrey of Philadelphia. About the same time, it is said, Captain Hadley of the British Navy announced a similar invention.

The sextant is an instrument by which the altitude of heavenly bodies above the horizon may be measured. It consists of a small telescope, mirror, reflector and degree scale so arranged that, when the instrument is placed in proper position and the

Point Reyes Light, California

heavenly body (sun, moon or star) is viewed through the telescope, the altitude of such body may be determined. By taking repeated observations as the ship goes forward, the direction in which the ship is sailing may be learned.

The Chronometer

While the invention of the sextant was a great step forward in the art of navigation, it was not until an accurate chronometer or timepiece was perfected that mariners were able to determine their position with any degree of accuracy. The exact time when observations are made is an important factor in the calculation, so important, indeed, that the British Government offered a prize of £20,000 (about $100,000) for the most accurate chronometer. The prize was won by John Harrison, an Englishman, who had devoted many years to the perfection of such a timepiece. He made an instrument which varied only one minute and five seconds during a voyage of five months from England to Jamaica and return. In comparison with the average watch or clock of today this is a remarkable record.

Ship chronometers and other instruments are mounted on gimbals to avoid, as far as possible, their being tilted from a level position by the motion of the ship. Gimbals are a kind of framework in which the instrument is hung so it will swing freely. Temperature affects the accuracy of chronometers, and mariners navigating in extremely hot or cold climates must take account of this fact. Radio time signals are now sent out from the United States Naval Observatory at ten o'clock each day, thus en-

abling ships having radio equipment to correct their chronometers.

Determining a ship's position by use of the instruments described above is termed "celestial observation." Other elements which the mariner must constantly consider are the wind, ocean currents and tides.

Tides

Your geography will tell you about tides. These vary at different points on the earth's surface. To enable a record to be kept of the ebb and flow of the tides, the government stationed observers at various ports for many years. Recently, however, an automatic gauge has been perfected which records the condition of the tide at all times and has replaced the observers, thus saving much expense.

The tide is at "flood" (in) and at "ebb" (out) twice each lunar day (about 24 hours 51 minutes) and not at given hours by the clock. The government issues tables for use of mariners, giving the time of high and low tide each day, at various ports. This information is essential as the larger ships can make many ports only at high tide.

Dead Reckoning

One of the most difficult problems of navigation is that of finding a ship's location on dark, stormy days or nights or in fogs, when the sun, moon and stars cannot be seen. Until recent years this could be done only by "dead reckoning." To make use of this system the navigator must have kept a record of

the ship's position when last obtained by "sight" and the time of such observation.

The direction in which the boat is traveling, as determined by compass readings, must be known. The navigator must also know the distance traveled. This is obtained by multiplying the speed of the boat per hour by the number of hours of elapsed time. Formerly the speed of a boat was determined by the simple method of throwing overboard a block of wood attached to a line and counting the time required for the line to run out a certain number of feet. This method was in common use for many years and was considered quite accurate. It is still used by large numbers of vessels. However, a more modern device is now in use on the better class of vessels. This device is towed in the water and has a miniature propeller which revolves at a speed corresponding with that of the vessel. The revolutions are transmitted by the towing cable to an instrument on the vessel, from which the speed may be read, as it is read from the speedometer of a automobile. The motion of the waves does

Berkeley Reef Beacon, Calif.

not seem to interfere with the working of this device.

At best, the results obtained by dead reckoning are not entirely accurate.

Since the general adoption of wireless equipment on ships, a radiocompass, or "direction finder," has been perfected by means of which the position of a ship may be determined at any time by means of signals received from land stations. This instrument is now rapidly replacing the system of dead reckoning.

Maps and Charts

For the assistance of mariners the leading nations issue large numbers of maps, charts and tables covering all phases of navigation, and these publications are constantly being revised. The United States government alone carries an average of 89,293 different charts. As an evidence of how carefully these charts are kept up-to-date, we note in a report of the Coast Survey that the chart for New York Harbor was corrected five times in a single year.

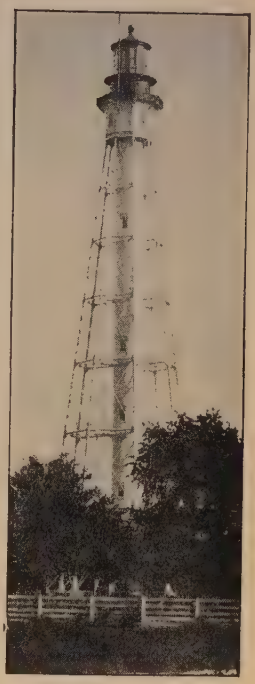
These charts are especially valuable in navigating the mouths of rivers where silt carried down by the current is constantly changing the channels, and along sandy shores where the action of the waves changes the shore line.

Piloting

We have spoken of the problems of navigation upon the open sea. As ships near shore, however, an entirely different method, referred to as "terrestrial observation," is adopted. The first requisite for this work is a nautical chart showing complete details of

the shore line and adjacent waters. On these charts such objects as rocks, hills, houses, trees, sand beaches, bluffs, small islands and anything by which the navigator might locate his vessel, are given in great detail. Lighthouses and other lights, buoys, floats and docks are shown. The depth of water, especially over rocks and shoals, is given. The character of the sea's bottom is also indicated, whether rock, sand, coral or mud.

By sighting land objects over his compass the navigator can accurately determine the position of his vessel. In stormy or foggy weather when the course cannot be steered by observing land objects, sounding may be employed. The depth of the water and character of the bottom compared with the chart, enable him to obtain the vessel's position with fair accuracy. Fog signals and warnings which are constantly sent out in bad weather also assist him.



Cape Charles Lighthouse, Va.

In piloting his vessel into harbors and upon rivers the officer has many buoys, posts and lights with special markings to enable him to keep within the channel. Pilots familiar with the waters are available at important harbors. As an illustration of the saying, "Experience is the best teacher," we might

cite the remark of an old pilot, that he ought to know the location of all the rocks in the harbor, for his boat had struck them all.

THE HEAVING OF THE LEAD

For England when with favoring gale
  Our gallant ship up channel steered,
And, scudding under easy sail,
  The high blue western land appeared;
To heave the lead the seaman sprung,
And to the pilot cheerly sung,
    "By the deep—nine!"

And bearing up to gain the port,
  Some well-known object kept in view,—
An abbeytower, a harbor-fort,
  Or beacon to the vessel true;
While oft the lead the seaman flung,
And to the pilot cheerly sung,
    "By the mark—seven!"

And as the much-loved shore we near,
  With transport we behold the roof
Where dwelt a friend or partner dear,
  Of faith and love a matchless proof.
The lead once more the seaman flung,
And to the watchful pilot sung,
    "Quarter less—five!"

Now to her berth the ship draws nigh:
  We shorten sail,—she feels the tide,—
"Stand clear the cable" is the cry,—
  The anchor's gone: we safely ride.
The watch is set, and through the night
We hear the seamen with delight
    Proclaim,—"All's well!"

Charles Dibdin.

Sounding

The old method of sounding was to measure the depth of the water by use of an ordinary line with a lead sinker attached, this device being called a plummet. You will realize that plummets were not mere toys when you learn that the small hand plummets weighed about eight pounds, while those for deep sea sounding weighed from twenty-five to thirty pounds and were operated by machinery.

To get an accurate "up and down cast" in deep water with the old-fashioned line it was necessary to stop the vessel. The tides also had to be considered as in some locations water is several feet deeper at high tide than at low tide.

To determine the nature of the sea bottom, tallow was placed on the bottom of the lead so that, when it struck bottom, shells, sand, coral or mud would adhere to the tallow.

There has been perfected a sounding machine which may be trailed behind a ship so that accurate depth measurements may be taken regardless of the speed of the vessel. It is a well-known fact that the pressure exerted by water increases with its depth. This sounding machine is so constructed as to accurately register the pressure of the water, thus enabling the navigator to determine its depth.

A more modern device called the Sonic Depth Finder has been developed by the United States Navy. It operates upon the echo system. To perfect this device it was necessary to know the time required for sound traveling through the water to be echoed back to its source. With this knowledge it was easy to determine the depth of the water from

the time interval of a sound wave traveling from the vessel to the ocean bottom and back. The Sonic System is now quite generally used on the larger vessels. A new development of this system enables mariners to determine their distance from shore.

Courtesy Chesapeake and Ohio Railway.

Original Cape Henry Lighthouse

LIGHTHOUSE HISTORY

FLOTSAM AND JETSAM

The sea crashed over the grim, gray rocks,
  It thundered beneath the height,
It swept by reef and sandy dune,
It glittered beneath the harvest moon
  That bathed it in yellow light.

Shell, and sea-weed, and sparkling stone,
  It flung on the golden sand.
Strange relics torn from its deepest caves,
  Sad trophies of wild victorious waves,
  It scattered upon the strand.

Spars that had looked so strong and true,
  At many a gallant launch,
Shattered and broken, flung to the shore
While the tide in its wild triumphant roar
  Rang a dirge for the vessel stanch.

Anonymous.

The thousands of voyagers who now "go down to the sea in ships" little realize the extent and variety of the safeguards which our government provides, at great cost of money and effort, for their benefit. While they enjoy the invigorating air on deck or sleep in their cabins, faithful men are keeping the lights burning as guides to the ship's officers. Brave men also stand ready to man lifeboats or swift sea-

going cutters, to give immediate aid, in case of need, regardless of difficulties or dangers.

Hearts of oak are our ships,
Hearts of oak are our men.

D. Garrick.

"Peace hath her victories no less renowned than those of war," is surely true of the Lighthouse and allied services of our country, for men of these services are almost constantly risking their lives to save the lives and property of others. It is not often that we hear their praises sung, but we know that they are at their posts of duty in lighthouses on the bleak coasts far from friends and neighbors; patroling lonely beaches during the long watches of the night; or manning light vessels located at dangerous stations.

The coast line of the United States and its possessions, including rivers, channels and the Great Lakes, where lights are necessary, is 55,900 statute miles in length. As aids and signals for vessels in the waters along this vast shore line there are 1879 lighthouses and 3920 minor lights, light vessels, and lighted buoys and floats. In addition, there are 2453 beacons, 7204 buoys, and numerous bell and whistling buoys and submarine fog signals.

Faithful Old Lights

At the time of the Boston Tea Party, famous in American history, there was a light in Boston Harbor on Little Brewster Island. It had then been burning for fifty-seven years. It guided into the

harbor that shipload of tea which was so dramatically disposed of. The same light has never failed, to this day, except for a brief period during the Revolutionary War when it was destroyed. This was the first of twelve important lights to be established by the colonies.

When Paul Revere rode through the night to arouse the Minutemen; when the battles of Lexington, Concord, and Bunker Hill were fought, these lights had kept faithful vigil for more years than most of the soldiers had lived; when Washington took charge of the army, when he crossed the Delaware, and when he became our first President, these lights were still glowing forth a welcome to returning mariners and a Godspeed to those departing from our shores.

Colonial Lights

The twelve colonial lights, with dates of their erection, are as follows:

Boston, on Little Brewster Island, Massachusetts 1716
Brant Point, Nantucket Harbor, Massachusetts.. 1746
Beavertail, on Conimicut Island, Narragansett Bay 1749
New London Harbor, Connecticut..... 1760
Sandy Hook, New Jersey, entrance to New York Bay 1764
Cape Henlopen, Delaware, entrance to Delaware Bay 1765
Charleston, on Morris Island, South Carolina.... 1767
Plymouth Light, on Gurnet Point, Massachusetts 1769

Portsmouth, New Hampshire, entrance to harbor 1771
Cape Ann Lights, Thacher Island, Massachusetts 1773
Great Point, Nantucket Island, Massachusetts.....1784
Newburyport Harbor Lights, Massachusetts.....1788

Although several of these structures have crumbled into ruin, new modern lighthouses have replaced them and the service has been maintained, each as "a light set on a hill that cannot be hid."

If we could visit these lighthouses and talk with the keepers, we would surely hear strange and wonderful tales of dangers and wild, stormy nights; of ships joyously returning after difficult voyages, and others which never returned; and of the long, dreary days, months and years which the keepers have endured for the safety of ships and passengers on the high seas. Surely, "They also serve who only stand and wait."

It is pleasant to know that many keepers now have radios which add much cheer to their lonely lives.

First American Lighthouse

The merchants of Boston appear to have taken the first steps towards the erection of a lighthouse for Boston Harbor when, in 1713, they presented a petition to the General Court of Massachusetts for the erection of such a beacon.

A committee appointed by the court reported favorably and recommended that the lighthouse be built on Little Brewster Island. The property holders also took a hand in the proceedings, as we are

told that, at a town meeting, the matter was considered and referred to the Selectmen, who made known their wishes to the General Court. The lighthouse cost less than $12,000 and the expense was met by the Province of Massachusetts.

The keeper of the Boston light received a salary of fifty pounds sterling (about $250) per year. It is said, however, that he was able to add to his income by piloting vessels into and out of the Harbor and by giving aid to vessels in trouble.

It was not until 1762 that the Assembly of New York authorized the building of a lighthouse on Sandy Hook, at the entrance to New York Harbor. The funds were raised by means of a lottery. A newspaper of June 18, 1764, published the following interesting item:

> "On Monday evening last the New York Lighthouse erected at Sandy Hook was lighted for the first time. The House is of an Octagon figure, having eight equal Sides; the Diameter at the Base 29 Feet; and at the top of the Wall, 15 Feet. The whole Construction of the Lanthorn is Iron; the Top covered with Copper. There are 48 Oil Blazes. The Building from the Surface is Nine Stories; the whole from Bottom to Top 103 Feet. The structure was undertaken by Mr. Isaac Conro of this city and was carried on with all the Expedition that the Difficulty attending to and fro on the occasion could possibly admit of; and is judged to be masterly finished."

As the walls were made eight feet thick at the bottom, one is not surprised to learn that this solid structure is still standing.

About a year after the Sandy Hook Lighthouse was put into operation, the now famous old structure at Cape Henlopen, Delaware, was erected. The £3000 to meet the cost of the building was raised by lottery. This lighthouse is still standing: it is, however, a "house built upon the sand" and, since Washington's time, there have been grave fears of the sea's washing away its foundation.

In 1789 Congress authorized the maintenance of lighthouses by the United States, and the colonies ceded to the general government those which they were then operating as well as the four which were under construction. The importance attached to the Lighthouse Service may be better understood when it is known that it was the first public service undertaken by our new government.

Virginia had assembled at Cape Henry nearly enough material for a lighthouse and in 1790 Congress included the cost of erecting this structure in its first appropriation for such purposes. Although this tower is still standing, it became unsafe for use and a new one was erected.

The colonies met the expenses of maintaining the lighthouses by levying light dues upon vessels. The fees charged in Boston Harbor were one penny per ton coming in or going out, except on coasting vessels, which paid two shillings each when clearing from the Harbor, other smaller vessels being charged by the year at the rate of five shillings each.

While we are not informed as to the total yearly income from these light fees, the fact that the object

of them was to maintain the few lights then in operation leads us to believe that they could not have exceeded a few thousand dollars. Compared with the present volume of business such a sum seems trifling, for we read that the tonnage receipts of our government for a recent year were $1,713,432.

Since the United States Government took over the Lighthouse Service it has been rapidly extended and improved. Now our waters are said to be the best lighted anywhere, and as our ports shelter so many of the world's ships it is easy to think of "Uncle Sam" as a good servant of the nations, always having his "lamps trimmed and burning."

Minots Ledge Lighthouse, Massachusetts

LIGHTHOUSE BUILDING

The Lighthouse

The rocky ledge runs far into the sea,
And on its outer point, some miles away,
The Lighthouse lifts its massive masonry,
A pillar of fire by night, of cloud by day.

Even at this distance I can see the tides,
Upheaving, break unheard along its base,
A speechless wrath, that rises and subsides
In the white lip and tremor of the face.

And as the evening darkens, lo! how bright,
Through the deep purple of the twilight air,
Beams forth the sudden radiance of its light
With strange, unearthly splendor in its glare!

Not one alone; from each projecting cape
And perilous reef, along the ocean's verge,
Starts into life a dim, gigantic shape,
Holding its lantern o'er the restless surge.

Like the great giant Christopher it stands
Upon the brink of the tempestuous wave,
Wading far out among the rocks and sands,
The night-o'ertaken mariner to save.

And the great ships sail outward and return,
Bending and bowing o'er the billowy swells,
And ever joyful, as they see it burn,
They wave their silent welcomes and farewells.

They come forth from the darkness, and their sails
Gleam for a moment only in the blaze,
And eager faces, as the light unveils,
Gaze at the tower, and vanish while they gaze.

The mariner remembers when a child,
On his first voyage, he saw it fade and sink;
And when, returning from adventures wild,
He saw it rise again o'er ocean's brink.

Steadfast, sere, immovable, the same
Year after year, through all the silent night
Burns on forevermore that quenchless flame,
Shines on that inextinguishable light!

It sees the ocean to its bosom clasp
The rocks and sea-sand with the kiss of peace;
It sees the wild winds lift it in their grasp,
And hold it up, and shake it like a fleece.

The startled waves leap over it; the storm
Smites it with all the scourges of the rain,
And steadily against its solid form
Press the great shoulders of the hurricane.

The sea-bird wheeling round it, with the din
Of wings and winds and solitary cries,
Blinded and maddened by the light within,
Dashes himself against the glare, and dies.

A new Prometheus, chained upon the rock,
Still grasping in his hand the fire of Jove,
It does not hear the cry, nor heed the shock,
But hails the mariner with words of love.

"Sail on!" it says, "sail on, ye stately ships!
And with your floating bridge the ocean span;
Be mine to guard this light from all eclipse,
Be yours to bring man nearer unto man!"

Henry W. Longfellow.

Difficult Tasks

The erection and maintenance of our lighthouses has called for unusual engineering skill and great courage and perseverance on the part of those who did the work.

One of the most dangerous points on our Atlantic coast is Cohasset, Massachusetts, near the entrance to Boston Harbor, where treacherous reefs extend two miles off shore. Year after year disasters occurred there with great loss of life, vessels and cargo. Finally, in 1847, work was begun on a lighthouse, on a rock which was above water only at low tide and was exposed to the ocean at all times. Work was carried on with great difficulty, it being necessary to anchor the structure by drilling deep holes into the rock.

This lighthouse was in operation less than a year and a half when it, together with its two keepers, was washed away by the sea in a heavy storm. A new lighthouse to replace it was promptly erected off the shore on Minot's Ledge. At that time it was regarded as a marvel of engineering skill, considering the hard conditions under which it was erected. An idea of the difficulties met may be gained from the fact that it required three years to prepare the foundation alone. On account of rough seas and the unusual precautions necessary for the safety of the

workmen, only a fraction of the time could be effectively employed. Longfellow tells us of this lighthouse in his beautiful poem, "The Lighthouse," which appears on preceding pages.

Unfriendly Indians

In the early days unfriendly Indians were a constant menace to the workmen who erected lighthouses. On the Pacific coast Indians made repeated attacks on the workmen and attempted to destroy materials and structures.

On the Florida coast during the Seminole War in 1836 one lighthouse was attacked by Indians and set on fire, cutting off the escape of the assistant keeper and his negro helper. They shot the negro and would surely have killed or burned alive the keeper, but for the timely arrival of a government cutter whose crew drove the Indians away and rescued the assistant by shooting a line over the burning tower. A sailor climbed up and made the rescue.

The Indians prevented the building of another lighthouse at that point for many years.

Perilous Work

The most difficult and dangerous work in the construction of lighthouses has been done on the Pacific coast. In the early days it was necessary to transport materials from the Atlantic to the Pacific coast around Cape Horn, the voyage taking about four months.

One of the first disasters of the service was the wreck of a vessel sent to those waters with materials

for the building of a number of lighthouses, all of the materials being lost.

At the mouth of the Columbia River is a high rock surrounded by deep water, on which a lighthouse was erected in the years 1879 to 1881. This rock is swept by the sea, and on account of the extreme depth of the water the waves run very high, often completely covering the rock.

In building the lighthouse it was necessary to hoist workmen and material from service boats to the top of the rock by means of a cable. It took the workmen all of one winter to blast off the top of the rock to prepare it as a foundation for the lighthouse. On several days when the waves rolled over the rock, no work could be done.

Reports of the keepers of this lighthouse indicate that much damage was done in succeeding storms, the force of the waves being such as to hurl rocks of great weight against the structure. In one storm the waves broke over the lantern, 133 feet above sea level. Later reports tell how other damage, including the carrying away of a portion of the great rock itself, has been done by wind and waves.

On account of the severe storms it is impossible for weeks at a time to leave this station, or to receive supplies. It is easy to realize that the life of the men on duty there is anything but pleasant. We quote from one report of the keeper:

> "I regret to state that on the evening of the 18th, or morning of the 19th, we lost a portion of the west end of the Rock, water and rocks coming over with so much noise

we could not tell when, and did not know it had departed before next morning when the sea went down so that we could go outside. At 12:35 a. m. on the 19th the sea came up and broke one pane of the middle section of the lantern, which also put the light out and flooded the watch room, as well as downstairs. To add to it all, the soot and ashes came out of the stove in the kitchen.

"At 12:50 a. m. we had the light burning and storm pane in for the rest of the night.

"Siren was running until the crash came, but making no regular blast on account of the water filling the trumpet too fast. After getting the light burning we closed down the fog signal, as the wind hauled to westward and cleared the atmosphere somewhat. Shortly afterward when taking siren out to clear it I found it filled partly full with rocks; therefore, the water could not get out of it." (Siren horns are about 100 feet above the sea.)

"Will also state that every one under my charge worked hard and faithfully, regardless of water and glass, everybody being drenched to the skin."

Building on Sandy Bottom

In Delaware Bay, a few miles from the entrance, is a very dangerous shoal of considerable extent called Brandywine Shoal. For several years a light-

ship was stationed at this point, but the heavy ice floes of the Delaware made it impossible to keep the vessel constantly on duty.

As the bottom of the bay is sandy, a good foundation for a lighthouse could not be obtained. After much thought the engineers adopted a plan which had been used in England. They constructed a great iron cylinder on the outside of which wide spiral wings were riveted, forming an immense screw. This they worked down deep into the sand. After it was placed in position the screw wings kept the cylinder from sinking further. Upon the top of the cylinder they erected a lighthouse. This structure was not durable, however, and a new one built of re-enforced concrete was erected in 1914, supported by a large number of wooden piles driven deep into the sand.

Other lighthouses have been built out in the water upon foundations of concrete laid in excavations in the sand. In laying these foundations, as the work proceeded, steel or iron cylinders, called "caissons," were sunk to keep out the water, thus enabling the men to work in safety.

THE BALLAD OF THE TEMPEST

We were crowded in the cabin,
  Not a soul would dare to sleep,—
It was midnight on the waters
  And a storm was on the deep.

'Tis a fearful thing in winter
  To be shattered by the blast,
And to hear the rattling trumpet
  Thunder, "Cut away the mast!"

So we shuddered there in silence,—
For the stoutest held his breath,
While the hungry sea was roaring,
And the breakers talked with Death.

As thus we sat in darkness,
Each one busy in his prayers,
"We are lost!" the captain shouted
As he staggered down the stairs.

But his little daughter whispered,
As she took his icy hand,
"Isn't God upon the ocean
Just the same as on the land?"

Then we kissed the little maiden,
And we spoke in better cheer,
And we anchored safe in harbor
When the morn was shining clear.

James Thomas Fields.

THE LIGHTHOUSE SERVICE

ORGANIZATION

Until 1903 the United States Lighthouse Service was in charge of the Treasury Department, but in July of that year it was transferred to the Department of Commerce, where it is now administered by the Bureau of Lighthouses.

The executive office of the Service is in Washington, under a commissioner and deputy commissioner of lighthouses. In this office are the engineering, construction and hydrographic divisions. Here the general policies and activities of the Service are decided and the plans for new lighthouses made. The district superintendents receive their instructions from this office and report to it.

The Service outside of Washington is divided into nineteen districts, each of which is in charge of a district superintendent of lighthouses. A technical force for construction and upkeep of both land and floating equipment, as well as one or more depots for storing and distributing supplies and apparatus, is maintained in each district. One general depot is located on Staten Island, New York Harbor, where many of the supplies for the whole Service are purchased and stored, to be distributed to the various districts. Such a central purchasing office saves the Bureau much in both money and number of employees.

Extent of the Service

The Lighthouse Service extends to the Atlantic, Gulf, Great Lakes and Pacific coasts, the principal interior rivers, Alaska, Porto Rico, Hawaii and all other territory under the jurisdiction of the United States, including various banks and islands in the Caribbean Sea. In the Philippine Islands the Service is maintained by the insular government and in Panama the lights along the canal and its approaches are supported from the general appropriations for the canal.

Except at a few remote points where lights are maintained by special arrangements, all of the work of the Lighthouse Service is carried on by its own organization.

The Great Lakes

Few people realize the extent of the commerce on the Great Lakes. The distance from Buffalo to Duluth is about one thousand miles. An enormous number of vessels ply these waters, and as there are many difficult passages, large numbers of lights, buoys and other marks are required.

The importance of Great Lakes navigation may be better understood when it is known that the tonnage, mostly iron ore, lumber, grain and copper, passing through the canal at Sault Ste. Marie is about twice the foreign trade entering and clearing from the port of New York.

Co-operation

The Lighthouse Service co-operates with other

Unattended Light, Alaska

government departments and activities. It joins with the Coast and Geodetic Survey in issuing notices to mariners and supplies information to that office and others, such as the Lake Survey, which publishes charts. It also co-operates with the Engineering Corps of the Army and with the War Department in making harbor improvements, marking river channels, lighting wrecks and giving other aids to navigation.

Telephone connection is maintained between most lighthouses and the Coast Guard, enabling them to promptly summon aid for vessels in distress. The Service is also of assistance to the Department of Agriculture in the protection of migratory birds, and to the Weather Bureau, which uses certain stations and light vessels for observation purposes.

In Time of War

The Lighthouse Service has been of great assistance during all our wars. During the Revolutionary War, Boston Lighthouse was repeatedly attacked and finally destroyed. The Sandy Hook Lighthouse also suffered much damage.

During the Civil War several light vessels and tenders were captured and sunk by the Confederates. Some of these were raised and repaired after the war. Practically all of the lighthouses on the southern coast were taken and the navigation of the coast waters as far north as Chesapeake Bay was made difficult and dangerous. The Lighthouse Service along these shores was fully reinstated as soon as possible after the close of the war.

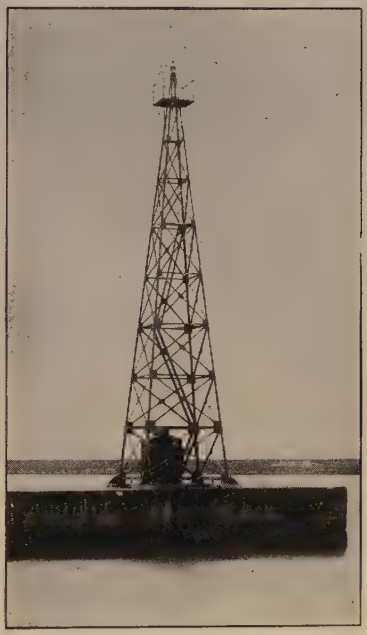
Livingstone Channel Light, Detroit River

During the Spanish-American War, vessels of the Lighthouse Service were transferred to the Navy Department for use as despatch boats, mine layers and supply vessels. Two lighthouse tenders, the *Mayflower* and *Mangrove*, gained much prominence at that time by their capture of Spanish vessels.

In 1916 the President was authorized, in case of great need such as war brings, to transfer whatever

vessels of the Lighthouse Service he might deem best, to the Navy and War Departments. In 1917 he thus transferred forty-nine vessels with their crews, numbering 1120 persons. During our participation in the World War, practically all the work of placing and maintaining defensive nets at the entrance to harbors was done by these vessels, as well as the laying of mines, placing of buoys and floating practice targets and doing patrol and special duty.

During October, 1916, the crews of three vessels destroyed by a German submarine were harbored on board one of our light vessels until transferred to a navy vessel. Valuable service was rendered by lighthouses along the Atlantic coast as lookouts for submarines.



West Pier Light, Ohio

On August 6, 1918, the Diamond Shoal Light Vessel stationed off Cape Hatteras, North Carolina, was sunk by a German submarine; but before she went down her wireless operator reported the presence of the submarine, thus warning and saving many vessels and their crews.

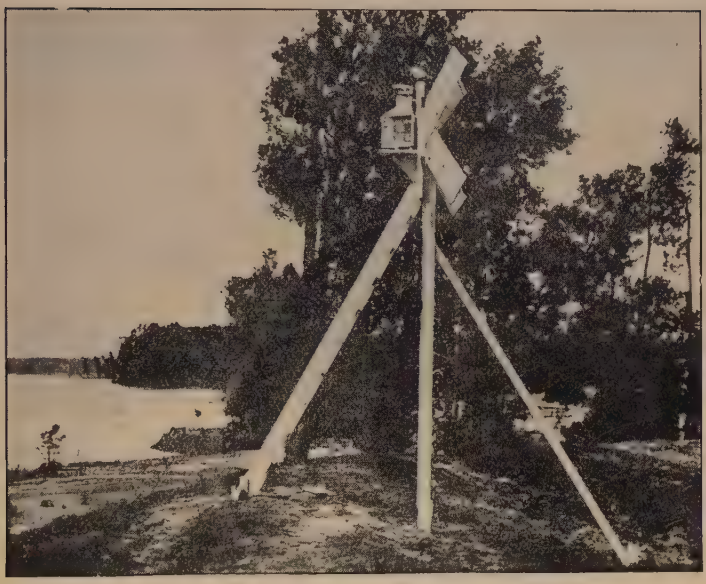
Types of Lighthouses

There are many types of lighthouses in use. The type adopted for a location depends upon the importance of the light and character of the foundation. The older structures were cylindrical towers with a wide base, made from native rock. In some structures homes for light keepers were combined with lighthouses. Many of the tall, high-powered stations of more recent times are of re-enforced concrete or skeleton steel construction. By referring to illustrations in this volume a good idea of various types will be obtained.

The height of lights depends upon their location and importance. A structure erected on a point high above the water does not need to be so tall as one built on a location in or slightly above the water, and a light which serves merely to guide vessels into a harbor does not need to be so tall as one carrying a strong light to be seen far out at sea. There are twenty lights over 150 feet high on the Atlantic coast; the tallest one, located at Cape Hatteras, North Carolina, is 193 feet high.

The lighthouse having the highest location is at Cape Mendocino, California. This is 422 feet above sea level and has a light range, under normal weather conditions, of about twenty-eight miles.

It is necessary to protect the lights in lighthouses with screens, to keep migratory birds from breaking the glass. Before these screens were erected, thousands of birds on their journeys north or south struck the lights, and, due to the swiftness of their flight, broke many panes of glass.



Mississippi River Post Light

Minor Lights and Other Warning Devices

A post light is generally a single timber post, with a shelf or bucket for the lantern. Some have ladders, and to assist in identifying them by day, wing boards are added. Such lights can easily be erected in the water where it would be difficult to erect lighthouses. Recently steel skeleton towers have been adopted instead of poles for this type of light.

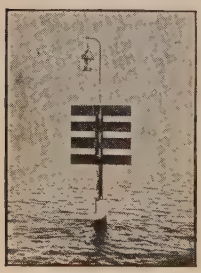
A large number of unlighted beacons and day marks are used, some being mere piles or stakes, with or without pointers to indicate the channel. Others are timber structures of various designs, with targets or other features to attract attention. Iron

or steel spindles having a barrel or crate at the top are also used, while some of the older types are stone monuments.

In localities where fog is prevalent, as on rivers in California, echo boards are erected. These are long, wall-like structures which enable passing steamers to obtain an echo from their whistles.

River Lights

Practically all of the navigable rivers of the United States are well marked with lights. These are mostly of a simple kerosene burning type known as post lights, and are usually set on river banks. They are attended by persons living in the vicinity.



Sand Shoal Inlet Light, Va.

By the manner in which the lights are set, navigators can tell the character of the river banks. In some cases range lights are set, one near the water's edge and another some distance back, to enable the helmsman to steer a true course by keeping his vessel in line with the lights. On many light posts, wings or other objects with numbers are attached to enable navigators to recognize them readily in daytime.

Kinds of Lights

The earliest known lighthouse was a tower at the top of which wood fires were burned. The Greeks had such lighthouses for the protection of their mariners. About 300 B. C. a most remarkable structure was erected at Alexandria, costing about a million dollars.

Duck Rocks Tripod Light, Maine

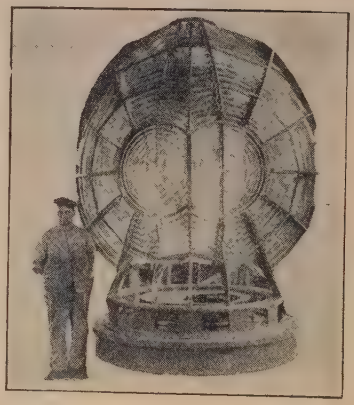
Marble was used for building this tower and it was so substantial that it stood for about 1500 years. During the Middle Ages the churches cared for the lighthouses. In the poem "The Inchcape Rock," mention is made of the abbot who placed the bell on the rock.

There were many famous lights in Europe, probably the most popular one being the Eddystone lighthouse in the English channel. On the continent the light at Genoa is said to be the most picturesque and that at Cordova, France, the most beautiful.

The first lighthouse of this country used oil burners enclosed in wooden frames fitted with panes of glass. These crude lights soon gave place to improved ones with silvered reflectors. From eight to twenty of these lights were arranged in a circle, so as to reflect light in every direction. In 1822 Augustin Fresnel, a Frenchman, perfected a lens that would throw rays of light a great distance.

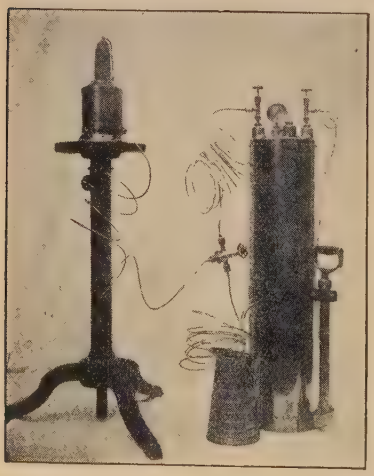
Many other improvements have been made in

lenses from time to time. The largest lens used by Fresnel was a trifle over 36 inches in diameter. The largest one in use at the present time is in the lighthouse at Makapu Point, Oahu, Hawaii. The inside diameter of this lens is nearly nine feet, and that of the lantern holding it sixteen feet.



Lens, Kilauea Point Light, Hawaii

Because the present-day lenses weigh from 12,000 to 14,000 pounds each, and must be revolved rapidly to give the desired "flash" to the lights, ordinary bearings cannot be used to advantage. Instead, the lens revolves in a bath of mercury.



Incandescent Oil Vapor Lamp

There are fifty-two United States lighthouses with candle power of 100,000 and twenty-two with 200,000 or over. The Navesink light, located on the New Jersey Highlands at the entrance of New York Bay, is the most powerful of all, having 710,000 candle power. It equals 60,000 ordinary lights.

Larchmont Breakwater Light, New York

The curvature of the earth's surface amounts to about three feet for each mile. The height of a light above sea level therefore determines the distance at which it may be seen. Under normal conditions the Navesink light may be seen twenty-two miles at sea. Ships have reported seeing the rays of this light in the sky seventy miles out at sea.

It has recently been announced that a great searchlight is to be placed in the tower of a sky-scraper in New York City, thirty stories above the street. It is estimated that this light will cast its rays 150 miles.

Illuminants

In 1716, when the first lighthouse was established in Boston Harbor, the fuel used in the lantern was

whale or fish oil. As the whale catch diminished, however, the price of this oil advanced until it became too expensive for the purpose and other kinds of oil were sought. Rapeseed oil was used to a limited extent, and (1867) for about ten years lard oil was used almost exclusively. When kerosene came into use it gradually replaced lard oil and soon became the principal fuel for lighthouse lamps.

In the more important lights an oil-vapor lamp is now generally used, burning vaporized kerosene under an incandescent mantle. The oil is vaporized by being compressed in a tank by a hand pump and discharged through a vaporizer. By means of a thermostat, an alarm is sounded if the light burns too high or too low.

Acetylene and oil gas are used in some lights, especially in buoys and beacons which are unattended. This form of light is very reliable, requiring only occasional filling. One such light on an island near Hawaii has burned night and day without interruption for over twelve years.

A patent "sun-valve" in use on many gas lights, turns on the gas when darkness comes and turns it off again at dawn. This valve is the invention of Dr. Gustaf Dolen of Sweden and won for him a Nobel Prize in 1914. In the device two bars of metal of equal volume are used; one is highly polished to reflect light while the other is coated with lampblack and absorbs light. Under the influence of the natural heat carried by light rays, the absorbent metal expands. The reflecting metal does not expand, as it does not absorb the light rays. The expansion of one bar makes the two of unequal length;

this difference is utilized to operate a valve, shutting off gas from a light. When darkness comes, the absorbent bar gives up its heat and again becomes of equal length with the polished bar, thus turning on the gas and causing the light to burn brightly.

Electric lights are now sometimes used, especially where several lights may easily be connected by cable. Some experimental lights operated from storage batteries have also been installed.

A device has been perfected which automatically turns on a new electric light when the one in use burns out. Automatic make-and-break mechanism is also provided for use with electric lights, which causes them to flash.

Cape Hatteras Lighthouse, North Carolina

LIGHTS

TWILIGHT AT SEA

The twilight hours, like birds, flew by,
  As lightly and as free,
Ten thousand stars were in the sky,
  Ten thousand on the sea;
For every wave, with dimpled face,
  That leaped upon the air,
Had caught a star in its embrace,
  And held it trembling there.

Amelia B. Welby.

Distinctive Lights

It is important that the navigating officer of a vessel be able to identify lights, and to this end they are given various distinctive features.

Lighthouses are of different types and are painted different colors and in varying designs. They may have wide alternate black and white stripes painted horizontally, vertically, or spirally. One method adopted was to build twin lights, but this was soon abandoned when it was discovered that if a vessel was in line with the two lights they appeared as one, thus confusing the mariner.

The older lights were "fixed" lights, and from a distance looked alike. Modern lights are principally of two kinds: flashing and occulting. Flashing is produced by revolving the lens, thus forming

the rays into beams. The lamp casts these beams at certain intervals. One may throw an intense light at equal intervals, another may also have regular intervals of light, but the time between them be longer or shorter. Still others may have unequal intervals of light and darkness; for example, the lens of one light may revolve six times per minute and flash each five seconds, while another revolves five times per minute and flashes each six seconds.

In occulting lights a screen is used which covers the light at intervals. Clockwork is used as a means of operating flashing and occulting mechanism. Thus, through variation in the intervals of flash and darkness, the various lights may be distinguished by the mariner. In another plan alternating red and white lights are used. By varying the periods of alternation the lights may be given individual character. This enables the mariner to determine his position, as he has charts and records giving the location and description of each light.

The importance of being able surely to identify lights may be illustrated by the fact that five wrecks were caused at one point along the North Carolina shore in a period of two and a half years by one light being mistaken for another. One of these lights was changed so as not to resemble any other; during two and a half years after this change no wrecks were reported.

FOG SIGNALS

Fog is one of the dangerous enemies of the mariner. Many devices have been used to give warning and enable navigators to determine their locations in foggy weather.

Fog is especially prevalent along the Maine coast, on the Great Lakes and about San Francisco, also along rivers in California and elsewhere. At the Seguin, Maine, station 2,734 hours of fog were observed in one year, while the average of ten stations for a number of years was 1,467 hours per year. Navigating in such waters is very dangerous.

The first fog signal which was used in the United States was a cannon that was fired at regular intervals during a fog. This gun was installed in 1719 on Little Brewster Island in Boston Bay, the same island on which the first lighthouse was built. It may still be seen there. Guns of various types were used for fog signaling but they were replaced by bells at an early date.

At first bells were rung by hand, but striking machinery was soon developed, governed by clockwork, ringing a regular code.

Recently a striking mechanism operated by compressed carbon dioxide has been put into successful operation on buoys. These buoys need no attendants and supply economical fog signals.

Bells weighing as much as two tons are in use at

land signal stations, but even these are not powerful enough for use on the seacoast.

The next improvement in fog signals was the introduction of the trumpet. The vibration of a steel reed or tongue in connection with a large horn gave forth a sound more penetrating than that of a bell, but the device was operated by horsepower and was not altogether satisfactory. It was not long, however, before a hot-air engine was used to sound the trumpet. This proved quite satisfactory and a number of these outfits were installed. Similar signals, mostly operated by internal combustion engines, are now in use on inland waters.

Steam whistles of the locomotive type were also introduced, some of them being eight or ten inches in diameter. These supplied more powerful signals than any previously used, and are still considered satisfactory.

Sirens were introduced in 1867. The first ones were made of cast iron, and shaped like a trumpet. Rotating disks and plates through which steam was discharged set up a terrific noise. Compressed air is now generally used to operate this form of siren. Several other types of fog signals have been devised, two of which deserve special mention: the "Sireno," an electrically driven blower siren, and the "Diaphone," a siren of different type from that operated by steam, and using compressed air. The largest of these sirens has been heard a distance of more than twenty-five miles.

Whistling buoys are used with much satisfaction in some localities for sending fog signals.

Every effort is made to sound signals as soon as

Cape Henry Fog Signal, Virginia

fog is observed, but as it often drifts in from the sea, vessels are sometimes surrounded by it before the signal station is aware of its presence. On account of varying conditions of the atmosphere, navigators cannot accurately judge the distance and direction of fog signals. Great caution is therefore necessary in navigating vessels in foggy weather. As a warning to other vessels navigators are required to blow their whistles while sailing through fog. In some localities traffic is entirely suspended in foggy weather.

Submarine Signals

Submarine signals, consisting of specially designed bells, have come into use during recent years. A striking device operated pneumatically rings the

bell, which is under water. Signals from such a bell are more dependable than those sent through the air. Submarine bells are also arranged on buoys, with striking mechanism which is set in motion by the action of the waves. However, as this action is irregular, no code can be maintained, and for this reason such bells are limited in usefulness and cannot take the place of bell signals controlled by clockwork.

Vessels are provided with receivers somewhat like those on telephones, which enable navigators to hear the submarine bell signals. By listening below the water line of vessels signals may be heard quite distinctly, even without receivers. They are heard more clearly in steel vessels than in wooden ones.

Radio Fog Signals

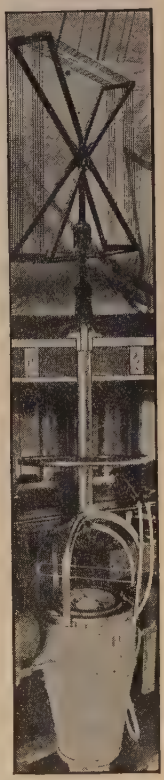
While you are listening to a concert or lecture on your radio it is quite likely that the navigating officer of some vessel off shore in the fog, without a visible object or light to guide him, is receiving radio signals sent from one or more stations along the shore to enable him to determine his exact location. Such signals are sent out constantly from lighthouse stations and light vessels at several points along the coast during thick or foggy weather. They are also sent on fair days from 9 to 9:30 a. m. and from 3 to 6:30 p. m., that all vessels equipped with radiocompass may test their apparatus in clear weather.

In 1910 a law was passed by Congress requiring all seagoing vessels to carry radio equipment.

As radio stations have different codes of signals, the navigator may determine by consulting his

charts the station from which he is receiving the signals. One station, for example, sends for twenty seconds and is silent for twenty seconds; another sends for twenty-five seconds and is silent for twenty-five seconds. By thus varying the intervals of sending and silence, also the number of signals sent per minute, a multitude of different codes may be arranged.

An international standard of 1,000 meters has been adopted for sending radio signals, and the range varies from thirty to one hundred miles, according to the sensitiveness of the receiving apparatus.



Radio Direction Finder or Radiocompass

The Radiocompass

After much experimenting, an instrument has been perfected which enables a navigating officer to determine his position quite as readily at night or in foggy weather as on bright days. It is called the radiocompass or direction finder. It receives radio waves from stations on shore and, by indicating the exact direction from which they come, enables the navigator to determine the location of his ship. By making repeated observations he can keep his course. During 1925, mariners made use of the direction finder a total of 150,000 times.

The radiocompass may be used to locate other vessels, to avoid collisions in fogs or at night, and to locate

vessels in distress. Most of the large ships are already equipped with this instrument and others are rapidly adopting it. Some of the great liners are using it more than any other navigating instrument. At many of the stations the equipment is so constructed as to send out signals automatically.

The radiocompass should not be confused with the wireless telegraph equipment of ships. The wireless is used by ships at sea for sending and receiving messages. The international code signal of distress, S. O. S. is sent out by wireless. Contrary to the belief of some people, these three letters do not stand for any particular words or expression.

The following cases will illustrate the value of the radiocompass in locating vessels at sea.

"A heavy gale left the Norwegian steamer *Onataneda* disabled, with engines broken down and a list of 50°, drifting helplessly off Newfoundland. The S. O. S. help call gave a position 90 miles out, due to lack of observations. Several vessels went to her assistance, but the only one able to find the disabled vessel was equipped with a radio direction finder (radiocompass) and was thereby enabled to save the lives of all those on board the *Onataneda.*"

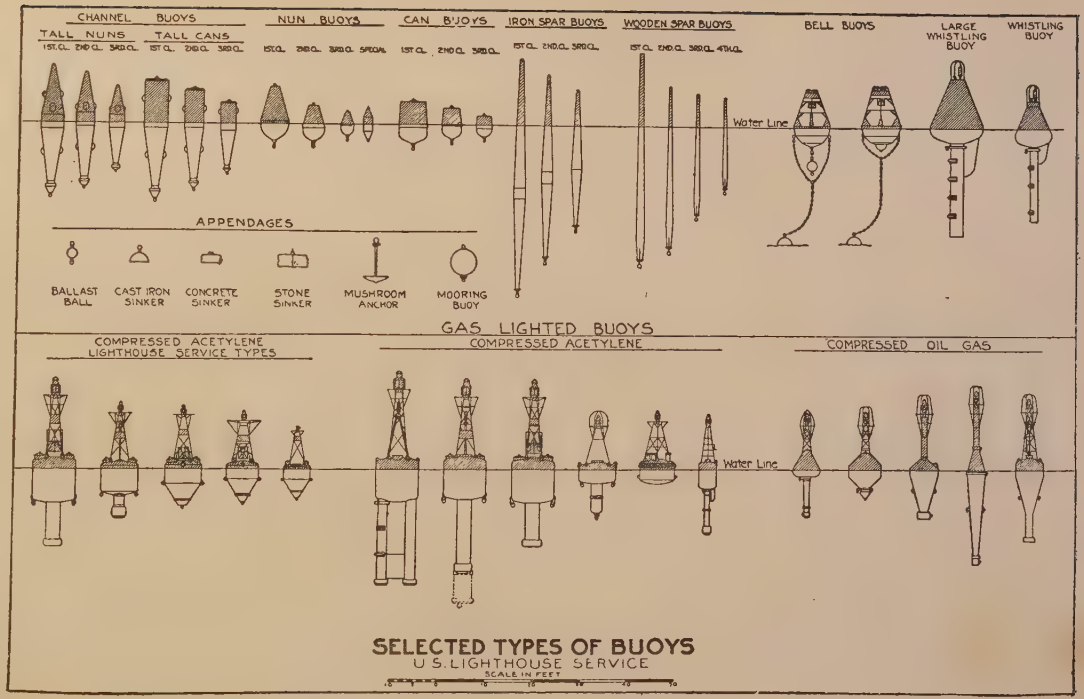
"On the night of March 15, 1922, the British steamer *Lord Strathcona* lost her propeller in a rough sea and sent out signals of distress. The American steamer *W. M. Burton* was assigned to assist her, but, upon arriving at her given position, no signs of the vessel could be seen. The captain of the disabled ship had had no 'sight' for a couple of days and was uncertain of his position. The visibility was poor, and nothing could be seen further than one mile. The British

ship *Cassandra,* which had a radio-compass, gave the bearing of the two ships, and very shortly afterwards the *Lord Strathcona* was sighted."

"When the *Eastern King* was 1700 miles west of Ushant on January 10, 1923, one of the seamen, who had been suffering for several days from internal injuries, lay in the ship's hospital in a critical condition. There was no doctor on board, and it became evident that the case called for skilled treatment. The captain sent out a general call to any ship bound for New York carrying a doctor. This call was promptly broadcasted, and in a few moments the large Italian passenger liner *Conte Rosso* answered. After an exchange of positions it was found that she was 300 miles to the eastward. By using her radiocompass she overtook the American ship at daylight the next morning, despite the fact that there was a dense fog. The ships met at 6:45 a. m., 1520 miles east of New York. The sick man was lowered into a lifeboat and placed under the care of two physicians on board the *Conte Rosso,* when the two ships separated."

Marconi, the inventor of the wireless telegraph, recently announced that he had perfected a system of sending wireless waves long distances to sea, in such form that the sending station may be easily and surely identified by its own signal given in Morse letters. By its use ships' officers are able to determine their location by comparing signals from two stations. The new device is referred to as a "radio lighthouse."

A new submarine system of fog warning has been devised in England, by which the sound waves from a siren are projected by wireless through the water and picked up by vessels.


CHANNEL BUOYS
TALL NUNS
1ST CL. 2ND CL. 3RD CL.
TALL CANS
1ST CL. 2ND CL. 3RD CL.
NUN BUOYS
1ST CL. 2ND CL. 3RD CL. SPECIAL
CAN BUOYS
1ST CL. 2ND CL. 3RD CL.
IRON SPAR BUOYS
1ST CL. 2ND CL. 3RD CL.
WOODEN SPAR BUOYS
1ST CL. 2ND CL. 3RD CL. 4TH CL.
BELL BUOYS
LARGE WHISTLING BUOY
WHISTLING BUOY
Water Line
APPENDAGES
BALLAST BALL
CAST IRON SINKER
CONCRETE SINKER
STONE SINKER
MUSHROOM ANCHOR
MOORING BUOY
GAS LIGHTED BUOYS
COMPRESSED ACETYLENE LIGHTHOUSE SERVICE TYPES
COMPRESSED ACETYLENE
COMPRESSED OIL GAS
Water Line
SELECTED TYPES OF BUOYS
U.S. LIGHTHOUSE SERVICE
SCALE IN FEET
0 5 10 15 20

BUOYS

ONLY A BUOY

Through sunshine and shadow and rain,
For months and years together;
Through fog and wind and storm,
In summer or winter weather;
I watch, and beckon and warn,
And do my duty with joy;
Guarding and guiding ships,
Although I am only a buoy.

As a safeguard to vessels it is important that dangerous points such as shoals, rocks and other obstructions, channel limits or fairways and anchorage grounds be plainly marked. Buoys of various kinds are chiefly employed for this purpose; those first used being solid wooden spars or barrels. Wooden spars are still used in certain localities, but for the barrel type, iron or steel is now used instead of wood. Nations generally follow a uniform practice of characteristic colors and numbers for buoys along the coast and in channels, bays and harbors. Our government has adopted the same policy.

Buoys are divided into two general types: lighted and unlighted. Lighted buoys use compressed gas or acetylene gas and to some of them bells and whistles are attached. They burn day and night from a month to a year or more without recharging with gas. Some

of the gas lights are so arranged as to flash brightly at given intervals, the periods of light and dark being subject to change by adjustment. By giving various buoys different intervals of light, navigators are able to identify them and know their exact bearings.

The illustrations on page 72 will give you a good idea of the various types of buoys. The largest whistling buoys are about sixty feet long and rise twenty-five feet above the surface of the water. These buoys weigh over 30,000 pounds.

Gas and Whistling Buoy

It is necessary to anchor buoys securely to keep them in position. Storms often carry them out to sea. A buoy located on our Atlantic Coast broke from its moorings and was found on the coast of Ireland six weeks later. A buoy found off the coast of Hawaii had broken from its station in San Francisco Bay, 1,900 miles away, seventeen months before.

It seems hard to believe that the ocean currents could carry a buoy so far, but the writer knows of a still more remarkable case. In 1912 a sealed bottle containing a name and address was thrown into the Ohio River at Louisville, Kentucky. Five years later it was picked up on the coast of California. As

there are no ocean currents which would carry the bottle around South America, scientists concluded that the bottle had been carried nearly around the world, on its journey to the Pacific Coast.

The action of the waves rocks the bell buoys and so causes the bells to ring. Whistling buoys are built of steel plates, and consist of a pear-shaped body with the smaller end uppermost, and a long open tube extending throughout the length of the buoy. This tube is closed at the upper end by a headplate on which is mounted a check valve and a whistle. The action of the waves causes the buoy to rise and fall in the water. When it falls, water is forced upward in the lower part of the tube, which compresses the air in the upper portion, causing it to escape through the whistle and make a loud noise. When the buoy rises again, the water falls in the tube, causing suction which draws air into the upper portion of the tube through the check valve. While no regular code can be given by these whistling buoys, on account of the irregular action of the waves, they are a great aid to navigation, especially to the smaller craft which frequently cruise the waters of bays and harbors.

A WET SHEET AND A FLOWING SEA

A wet sheet and a flowing sea,—
  A wind that follows fast,
And fills the white and rustling sail,
  And bends the gallant mast,—
And bends the gallant mast, my boys,
  While, like the eagle free,
Away the good ship flies, and leaves
  Old England on the lee.

O for a soft and gentle wind!
I heard a fair one cry;
But give to me the snoring breeze
And white waves heaving high,—
And white waves heaving high, my boys,
The good ship tight and free;
The world of waters is our home,
And merry men are we.

There's tempest in yon hornèd moon,
And lightning in yon cloud;
And hark the music, mariners!
The wind is piping loud,—
The wind is piping loud, my boys,
The lightning flashing free;
While the hollow oak our palace is,
Our heritage the sea.

Allan Cunningham.

LIGHT VESSELS

There are some conditions which cannot be met by the use of lighthouses or buoys, such as reefs, shoals, sand bars and approaches or entrances to harbors. Light vessels have proved most satisfactory for this service. There are in use over sixty light and relief vessels, about half of which have radio equipment.

In addition to lights, certain vessels are equipped with fog signals, either whistles or bells, some of the bells, being submerged for under-water signaling.

From their distinctive shape and their names painted in large letters on each side, lightships may be readily distinguished by day. At regular intervals these ships are brought in for docking, overhauling and repairing, when relief ships take their places.

The average life of light vessels is thirty years and it is necessary to build two new ones each year to replace those which go out of service. Recently new vessels have been built at the rate of about five per year. To assist in keeping light vessels in position during storms and to provide motive power for navigating them in case they are driven from their positions or when taken in for docking and repairs, engines are installed in them.

Located as most of these vessels are at extremely dangerous points, where they are almost constantly buffeted by strong winds and swept by heavy seas,

Lighthouse Tender "Cedar"

they perform one of the most difficult and dangerous tasks in the Lighthouse Service. Although they carry lights and sound fog signals, they are often damaged by collision with other vessels.

On account of heavy seas these vessels occasionally drag their anchors or break loose from their moorings, although the chains with which they are moored are very heavy and strong. (The chain with which the Diamond Shoals Lightship is anchored is 900 feet long and weighs 23,000 pounds.) Vessels thus set adrift are often driven ashore or upon rocks or reefs where they suffer great damage and are sometimes totally destroyed. We are told of one vessel stationed on the New England coast that broke adrift after a collision

Diamond Shoal Lightship, N. C.

and disappeared. Over a month later its captain reported from New Orleans that, to avoid going on the shoals after the accident, he made for the open sea. The heavy winds utterly destroyed the ship's sails. The crew, by working at the pumps, kept the ship afloat. When they were nearly exhausted they made signals of distress and, with great difficulty, were taken off by a passing vessel bound for New Orleans.

Service on lightships calls for great courage and devotion on the part of both officers and crew. It is sometimes necessary for them to stay on duty almost constantly night and day for several days, during stormy or foggy weather. Such passages as the following, in the reports of officers of these vessels, are not uncommon:

"All day yesterday and all last night we had the heaviest S. E. gale that I have experienced here. About midnight she was breaking all over the ship, but we managed to keep on the station and the light

and fog signals going all night. Everything that we are able to will be put in order. All is well on board."

Lighthouse Tenders

To furnish supplies and equipment to lighthouses and light vessels and provide for proper inspection, the government maintains over fifty vessels which travel a total of nearly half a million miles per year. These are rather small, sturdy vessels, rigged with derricks for handling buoys and heavy material. They are constructed with special view to their seaworthiness as they must go out in all kinds of weather and some times in severe storms. The placing and tending of buoys is one of the chief duties of these vessels.

The *"Cedar,"* on duty in Alaskan waters, is a typical boat of this class and is the largest in the service. It is 200 feet over all, 36 feet beam and has a displacement of 1,800 tons. An illustration of it appears on page 78 of this volume.

Botanical names such as *"Cedar", "Maple", "Tulip", "Lilac", " Pansy"* etc. are given to the vessels of this class.

THE COAST GUARD

THE COAST GUARD

Do you wonder what I am seeing,
  In the heart of the fire, aglow
Like cliffs in the golden sunset,
  With a summer sea below?
I see, away to the eastward,
  The line of a storm-beat coast,
And I hear the tread of the hurrying waves
  Like the tramp of a mailèd host.

And up and down in the darkness,
  And over the frozen sand,
I hear the men of the Coast Guard
  Pacing along the strand,
Beaten by storm and tempest,
  And drenched by the pelting rain,
From the shores of Carolina
  To the wind-swept bays of Maine.

No matter what storms are raging,
  No matter how wild the night,
The gleam of their swinging lanterns
  Shines out with a friendly light.
And many a shipwrecked sailor
  Thanks God, with his gasping breath,
For the sturdy arms of the surfmen
  That drew him away from death.

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Coast Patrolman Burning Signals

And so, when the wind is wailing
And the air grows dim with sleet.
I think of the fearless watchers
Pacing along their beat.
I think of a wreck, fast breaking
In the serf of a rocky shore,
And the lifeboat leaping onward
To the stroke of the bending oar.

I hear the shouts of the sailors,
The boom of the frozen sail,
And the creak of the icy halyards
Straining against the gale.
"Courage!" the captain trumpets,
"They are sending help from land!"
God bless the men of the Coast Guard
And hold their lives in His hand.

Emily Huntington Miller.

One of the most active arms of the government service relating to shipping is the United States Coast Guard. It was established by act of Congress in 1915 by combining the former Life Saving Service and Revenue Cutter Service. The objects for which the Coast Guard is maintained are set forth in a government report as follows:

1. Rendering assistance to vessels in distress and saving life and property.
2. Destruction or removal of wrecks, derelicts, and other floating dangers to navigation.
3. Extending medical aid to American vessels engaged in deep sea fishing.
4. Protection of the customs revenue.
5. Operating as a part of the Navy in time of war or emergencies.

6. Enforcement of law and regulations governing anchorage of vessels.
7. Enforcement of law relating to quarantine and neutrality.
8. Suppression of mutinies on merchant vessels.
9. Enforcement of navigation laws.
10. International ice patrol of Grand Banks.

The chief officer of the Coast Guard, with title of Commandant, is selected from those of lower rank and is appointed by the President. There are 4000 officers and enlisted men under him. Training and discipline are maintained, especially on the larger vessels, tending to fit the service for joining the Navy in cases of emergency.

A Coast Guard Landing Party

Coast Guard Academy

An academy for the training of cadets is maintained by the Coast Guard at New London, Connecticut. Its

graduates become commissioned officers of the line and of the engineering corps. The usual course covers three years. The young men receive instruction in seamanship, navigation, ordnance, marine engineering and in other matters peculiar to the profession of a seagoing officer; also in academic subjects such as English, mathematics, international law, science and French.

An extensive practice cruise is made each year, with the object of giving the cadets practical training in the theoretical studies pursued at the Academy.

THE MINUTE-GUN

When in the storm on Albion's coast,
The night-watch guards his weary post,
  From thoughts of danger free,
He marks some vessel's dusky form,
And hears, amid the howling storm,
  The minute-gun at sea.

Swift on the shore a hardy few
The lifeboat man with a gallant crew
  And dare the dangerous wave;
Through the wild surf they cleave their way,
Lost in the foam, nor know dismay,
  For they go the crew to save.

But O, what rapture fills each breast
Of the hopeless crew of the ship distressed!
  Then, landed safe, what joy to tell
Of all the dangers that befell!
Then is heard no more,
By the watch on shore,
  The minute-gun at sea.

R. S. Sharpe.

Coast Guard Cutter Modoc

Coast Guard Vessels

There are over one hundred vessels engaged in the Coast Guard Service. About a quarter of them are cutters capable of making fast speed in the open sea, and carrying from one to six guns. Many of the vessels of the service are built to operate in heavy seas and all kinds of weather in giving assistance to vessels in distress. As they must often sail long distances, they must also be capable of carrying a sufficient quantity of supplies to last many days.

The coast line of the United States is organized in seven divisions, each having a large number of stations. According to the latest available government report there are 325 stations altogether. They are

Hauling a Surfboat to the Beach

equipped with lifeboats and rigging and are manned by trained life guards.

At Coast Guard stations a fixed beat or patrol is laid out in each direction along the shore. The station crew is divided into regular watches of two men each, who, during the hours from sunset to sunrise, patrol these beats, keeping a sharp lookout seaward at all times. Each patrolman carries a number of red signals to burn and give warning to vessels too near the shore for safety, or to notify vessels in distress that he will summon assistance. The same system of patrol is maintained on dark and foggy days. To make sure that the men are faithful in the performance of their duties, they are required to keep records and make reports.

If a vessel needs assistance, it is rendered without delay, and if one station requires help other stations are notified at once.

Launching a Surfboat

In cases where ships out at sea send wireless calls for help (called SOS calls), one or more fast boats, with necessary equipment, supplies and men, are immediately despatched. When distressed vessels do not give their exact location, it may be learned quite accurately by means of a radiocompass on shore, if the distressed vessel carries radio equipment.

Such experiences as the following are common in the Coast Guard Service:

"West Palm Beach, Fla., Nov. 4, 1925—After battling all day with a heavy sea the crew of the Coast Guard cutter took Ed Stokes of Warrington, Va., owner, and nine members of the crew from their vessel, off Vero Beach, at 5:30 o'clock this afternoon. The craft is pounding to pieces."

"On the night of December 13, 1915, an unknown vessel was discovered by the patrol of the Hunniwells Beach station at anchor in a dangerous position inside Seguin Island on the coast of Maine. A close watch was kept upon her throughout the night. Wind and sea having risen by morning, the keeper made ready a boat and breeches buoy gear and sent a radiogram to the cutter *Ossipee*. Shortly after dawn the schooner set her ensign, union down [signal of distress], and the station prepared to undertake the rescue of her crew. About eight o'clock the tug *Sequin* appeared off the station and took the surfboat in tow in an attempt to get out over the bar in order that the Coast Guard crew might attempt to reach the schooner from the outside, but the state of the sea compelled her to turn back.

"At 9:50 a. m. the *Ossipee* anchored near the vessel. As the sea was too rough for lowering a boat, the cut-

Self-Bailing, Self-Righting Motor Lifeboat

Surfboat Landing Survivors from a Shipwreck

ter shot a line over her and sent a 7-inch hawser on board. With everything ready, the schooner tried to slip her cable, but in doing so the hawser chafed and parted. At noon, the sea having moderated, the cutter put a 10-inch line on board the schooner and, after considerable difficulty, took her in tow. She was taken to Boothbay Harbor, where surgical aid could be obtained for her master, who had been severely injured."

Nine Vessels to Rescue One

As an example of the difficulties encountered in assisting a vessel on the high seas we quote the following from the 1920 report of the Coast Guard:

"While crossing the Atlantic, the U. S. Army transport *Powhatan,* when only 500 miles east of Boston, became disabled. She is a large vessel and valued at $2,500,000 and carried a cargo of equal value, also 500 passengers. Three Coast Guard cutters, the *Ossipee,*

Acushnet and *Gresham* went to the rescue. The British steamship *Lady Laurier,* the U. S. destroyers *Leary* and *Sharkey* and the steamship *Western Comet* also assisted. When the vessels arrived they immediately sent boats and transferred 102 passengers to the *Northern Pacific,* after which the *Lady Laurier* took the *Powhatan* in tow for Halifax, Nova Scotia. Due to the disabled condition of the *Powhatan* it was necessary for the *Acushnet* to run a line to her bow to assist in steering.

"On the following morning both lines parted and it was necessary to replace them, the same thing occurring twice during the day, when progress was delayed until a 2-inch wire cable and a 15-inch hawser could be secured. Meantime a strong northeast gale and a blinding snowstorm had set in, causing the various ships to lose sight of the *Powhatan.* It was not until the afternoon of the next day that the transport was again sighted.

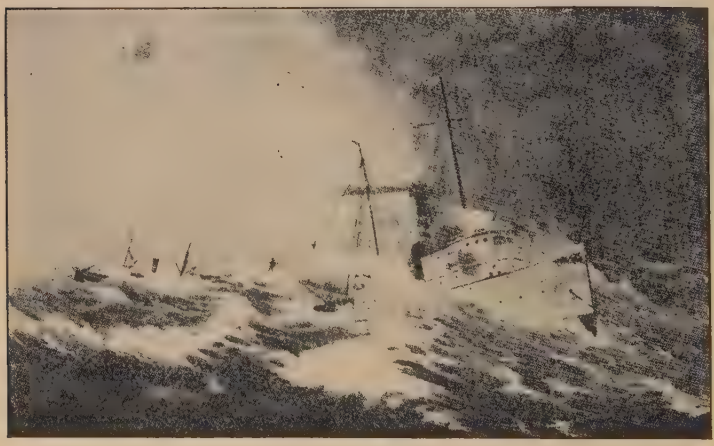
"That night the steamer *Relief,* owned by a wrecking company, came up and the next morning, the wind and sea having abated, the *Relief* put a line aboard the *Powhatan's* port bow and the *Ossipee* got an 8-inch line to her starboard quarter. The tow once more started ahead, with the *Ossipee* steering the *Powhatan,* the *Acushnet* towing ahead of the tug relief, the latter vessel towing from the bow of the *Powhatan,* and the *Lady Laurier* and *Gresham* acting as convoy. Again the weather became bad and it was with great difficulty that the *Powhatan* was held on her course, as she was steering badly and sheering 45 degrees on each side of the course. Early in the afternoon of

January 27th, five days after the vessel was first reported as in distress, Halifax light vessel was sighted and shortly thereafter the assisting vessels were successful in taking the disabled transport into port."

Sailors Burn Ship to Bring Help

In October 1925 the freighter *Algiers* set out with twenty-two officers and men from Philadelphia to New York.

For so short a journey only a scant supply of food



Saving Life at Sea by Means of a Breeches Buoy

and water was thought necessary. In fact, the ship was an unfit old hulk bound for the wrecking yard. She had no radio equipment. When fifteen hours out from Philadelphia, she was caught in a bad storm and drifted helplessly out to sea. The crew burned all their flares without attracting attention. Day after

day they drifted until their food and water were gone and they were nearly exhausted from weakness and the labor of pumping out water to keep afloat. At last, just before darkness on the fifteenth day, smoke was discovered on the horizon and they knew a ship was near. But how could they attract its attention?

Captain Harmon was a World War sailor. He had been "blown up" while on a mine sweeper. He had taken chances; he could do it again. "Tear up the decks and set fire to the ship," he commanded. The men were almost too weak to obey, but they sprinkled the decks with kerosene and set it on fire. The glare of the burning ship, in the twilight, attracted the attention of the passing ship, which reached the burning *Algiers* two hours later, in time to pick up the half-crazed sailors who had left their ship in lifeboats to avoid sinking with her.

Captain and Wife Saved

"Rochester, N. Y., Nov. 27, 1925—Bucking a northwester and driving snowstorm in an open power surf boat, Captain Nathan McCune of the United States Coast Guard, Summerville station (Lake Ontario), and eight coast guardsmen, added another credit mark to their record Wednesday night when they rescued Captain Jack Long and his wife from the barge *Gloria*, which had gone aground 300 feet off shore, just west of Nine Mile Point.

"The *Gloria* had broken away from the tug *Belle Russell*. Captain McCune effected the rescue with their light craft threatened with destruction against the side of the barge. Captain Long and his wife were

taken to the station, both suffering from exposure."

The report of a single year shows 1719 instances of lives saved; 1002 other instances of assistance; 2,417 lives saved; 8,427 persons on boats assisted; 561 persons in distress cared for. Vessels and cargoes valued at $65,479,705 were saved and derelicts valued at $630,000 rescued and delivered to their owners.

WHERE LIES THE LAND?

Where lies the land to which the ship would go?
Far, far ahead, is all her seamen know;
And where the land she travels from? Away,
Far, far behind, is all that they can say.

On sunny noons upon the deck's smooth face,
Link'd arm in arm, how pleasant here to pace;
Or, o'er the stern reclining, watch below
The foaming wake far widening as we go.

On stormy nights when wild north-westers rave,
How proud a thing to fight with wind and wave!
The dripping sailor on the reeling mast
Exults to bear, and scorns to wish it past.

Where lies the land to which the ship would go?
Far, far ahead, is all her seamen know;
And where the land she travels from? Away,
Far, far behind, is all that they can say.

Arthur Hugh Clough.

Rescuing or Destroying Derelicts

When a ship is abandoned at sea it is called a derelict. It may have been burned to the water's edge or

for some other reason have become unseaworthy. The officers and crew may have taken to their lifeboats or been taken off by passing ships or vessels of the Coast Guard. Barges, hulls or other vessels being towed sometimes break away and become derelicts.

Such abandoned vessels are a menace to navigation, as passing ships might be injured or wrecked by striking them. It is the duty of the captain of an abandoned vessel to report it to the U. S. Hydrographic Office, Washington, D. C., as soon as possible, giving the latitude and longitude as nearly as he can. It is also the duty of the officers of ships sighting derelicts at sea to report them.

As soon as a report of a derelict is received, a vessel of the Coast Guard is sent out to rescue or destroy it. Even when the exact position is reported, a derelict is likely to have been carried a long distance by the wind and waves or ocean currents before a Coast Guard vessel can reach the location, so it is important that the report should include all possible information as to conditions.

Often it is necessary to search for many hours or even days before locating a derelict. If the injured vessel is valuable and can be saved by pumping out or slight repairs such as the crew of the Coast Guard vessel can make, they immediately set about preparing it for towing into the nearest harbor. Sailing vessels which have been caught in a storm and their rigging destroyed, may often be towed in just as they are.

The following reports will illustrate the work of caring for derelicts.

Difficult Cases

"The engines had been removed from the Brazilian barge *Nepthis* and she was under tow from Brazil to New York for Diesel installation when she broke away from her towing vessel and became a derelict. She was abandoned on December 16, 1916, in latitude 40° 24′ north, longitude 70° 30′ west, her crew having been taken off by an Italian steamer. Five days later, information having come by radio, the *Seneca* put to sea in search of her. The locality in which she was last reported was searched, but no trace of her could be found. It was, therefore, presumed that she had sunk as, when last seen, she was at anchor with her decks awash. The search was continued, however, and the derelict was found the following day in latitude 39° 40′ north, longitude 72° 09′ west, lying beam to wind and sea and making good weather of a south gale.

A Derelict

"A boat was launched to run a line to the barge, but a rising wind and a heavy sea compelled the boat to return to the cutter. During the night nothing could be accomplished, but on the following morning the *Seneca* again located the derelict which had drifted

away in the darkness. The barge was weathering the gale fairly well. During that day the cutter could do nothing on account of bad weather. On the morning of the 24th a boat's crew succeeded in putting a 10-inch line on board and the cutter got under way towing the derelict. The following morning the northwest wind suddenly freshened to a gale, making a bad sea. An hour later the hawser chafed against the barge, once more setting her adrift. She drifted at the rate of two and one-half miles per hour and as it was evident

Recovery of a Derelict

she would soon founder if not assisted, a buoyed line was sent down to her, the launching of a boat being out of question, and a hawser was again run. The extent of this task will be understood when it is stated that it consumed five hours of discouraging labor, there being no power on the barge for handling the

lines. With the hawser finally secured, the *Seneca* steamed ahead and on the morning of the 26th, five days after beginning her journey, she turned the barge over to her owners at the port of New York."

"On January 29, 1915, word was received of a derelict, bottom up, 85 miles north by east of Diamond

Cold Spring Coast Guard Station, New Jersey

Shoals Light Vessel. The cutter *Seminole* was sent in search of it and attempted to tow the hull into Lynnhaven Bay, Virginia, but the vessel's anchor caught. The *Seminole* made an effort to part the anchor chain, first by mine charges and later by starting the cutter at full speed, but without success. An attempt was then made to sink the hulk by firing projectiles into it in order to release the imprisoned air, which was

thought to be keeping her afloat. This also failed, probably on account of the nature of her cargo, which was lumber. The *Seminole* was obliged to proceed to Norfolk to obtain rations, and the derelict was turned over to the *Itasca*, which had joined the *Seminole*. As a moderate sea was breaking over the hulk, making work on her impossible, an officer and one man were sent to place a light on the craft for the night. They succeeded in leaping from the boat to the keel of the schooner, where, in spite of the sea breaking over the wreck, the light was firmly secured. The cutter stood by until the following day, when after one unsuccessful attempt the anchor chain was finally broken by use of a mine, and the cutter took the derelict in tow for Chesapeake Bay. The *Itasca* was joined by a tug off Cape Henry whistling buoy, which took over the derelict and towed it to Newport News to await the arrival of the owner."

"While cruising in search of derelicts in the Gulf of Mexico in September, 1915, the *Tampa* located the schooner *Oscar G.*, which was water-logged and badly wrecked with stumps of fore and main masts standing, one mast floating alongside, starboard anchor trailing with chain run out and rudder unshipped. As she was lumber laden, it was necessary to pull her to port. A crew was sent on board to clear up the wreckage, as far as possible with the heavy seas constantly breaking over her, in order to put her in condition for towing. Finally a line was secured, and it was decided to tow her to Tampa, Florida. Although the schooner yawed considerably, fair progress was made until midnight when the wind and sea began to

increase; by the following morning it had become a tropical hurricane. To abandon the derelict would have required another search to locate her after the storm. It was therefore decided to use the schooner as a sea anchor for the cutter. The tow was shifted from the stern to the bow of the *Tampa,* and the hurricane safely ridden out. As the gale subsided, the derelict was again taken in tow and arrived at Key West four days after it was first sighted."

Destruction of a Derelict

Ships which cannot be saved are immediately destroyed, but this is not the simple matter that it might at first appear. The task is nearly always a difficult one and often fraught with grave dangers. Skilled seamen and staunch, well equipped boats are necessary for the work.

The usual method of destroying derelicts is by explosions in their hulls or by floating mines against them to make holes for the water to rush in, thus sinking

them. As this work must often be done in rough seas, it is dangerous and hard to accomplish. If seas are running high it is sometimes impossible to float mines against the derelict or put men aboard with them. In such cases it is necessary to stand by until conditions are more favorable. In rough weather it is difficult even to fire holes in a hulk with the ship's guns, to sink it.

Wreckers

At one point on the New England coast, before a lighthouse was erected, a large number of people made their living by salvaging.

The wrecking business is still an active and profitable one. Generations of wreckers have lived and thrived on Cape Cod, where they are still well regarded.

Wreckers are divided into two classes, known as "anchor draggers" and "beach combers." The anchor draggers work offshore, dragging the bottom of the sea to locate abandoned or lost anchors or other objects of value which may be raised. The beach combers wait until ships come ashore, when they board them and carry off articles of value.

There are wrecking companies which make a business of raising sunken vessels and salvaging as much as possible of the ships, their equipment and cargo.

THE KEEPERS OF THE LIGHT

We are the keepers of that steadfast light
That guides a people's course and destiny;
Not ours the skill directing over the sea
The mighty beams that blaze aright:
Ours but the hands that, serving, keep it bright;
The bringers of the oil, the workers we
Who day long, without pause and faithfully,
Toil that its radiance may pierce the night.

Above us are the wills that guide and turn;
It is not ours to watch nor question these:
Ours but to see each wick is trimmed and fit;
Lest on a night of storm it fails to burn
And a Great Ship goes down in awful seas.
O Keepers of the light, keep faith with it!

Theodosia Garrison.

ICE PATROL

Flashed through the air on April 14, 1912, came a wireless message which startled the world as it had not been startled in years. The largest of ocean steamships, the *Titanic,* on her maiden voyage across the Atlantic, had crashed into an iceberg. Inside of four hours she sank with a loss of 1,503 of the 2,206 souls aboard. It was the greatest marine disaster of all history. The *Titanic* had been sailing along majestically when the collision came, and had been on her regular course, some 1,600 miles east of Newfoundland. Until this shipwreck, the world had not fully realized the great danger of navigating the waters of that region. In fact, it is doubtful if most people had thought of any of our ocean liners as passing through a region made dangerous by floating ice.

It seems natural to think of ships sailing due east when they leave the United States for Europe. If you will look at a globe, however, you will see that the shortest route from New York to Liverpool lies far to the north of a direct easterly course and that the ships pass quite near to Newfoundland. A wide area of the sea off the Newfoundland Banks is the most dangerous along the Atlantic trade routes. Each spring when the ice breaks up in the northern seas, vast quantities of it drift out into the Atlantic and present a constant menace to navigation. Great mountains of

ice are continually breaking off from glaciers as they crowd down into the water, and these float out into the open sea as icebergs.

Solid ice masses a mile in extent and rising 200 feet above the water have been known. As only about one-seventh of an iceberg is above water, a height of 200 feet visible, means about 1200 feet below the surface. As such bergs float southward into warmer water they gradually melt and great pieces of ice break off,

Coast Guard Ice Patrol

forming smaller bergs, each of which constitutes a danger to navigation.

For years many vessels, to avoid these ice fields, travelled a longer route to the south of the usual one, during the spring and early summer. The advantages of the shorter route in saving of time, fuel, and other expenses were so great, however, that the leading maritime nations decided to combine to maintain an international ice patrol of the waters in the danger

zone. The purpose of the patrol is to locate and keep in touch with dangerous ice and report its location by radio to stations on shore. These, in turn, broadcast the information to vessels on the high seas.

It was not found practicable for the various countries interested to maintain vessels in these waters, so an agreement was made providing that the entire duty of ice patrol should be performed by the United States, each of the nations contributing its proper share toward meeting the expense.

The service calls for at least two vessels, one of which must always be on duty during the danger

A Stranded Steamer, Washington Coast

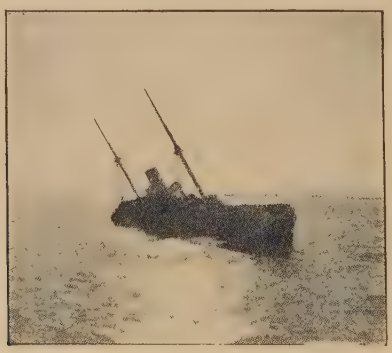
period. Whenever icebergs or fields of ice are discovered, the vessels must determine their extent and make repeated reports of their position as they float southward, until the ice melts. This patrol duty is continued each season until all danger is past, usually about the last of June.

Various attempts have been made to blow up icebergs to hasten their melting, but this has proved

dangerous and expensive and the results have not been very satisfactory.

Coastal Communication

For efficient conduct of the Coast Guard and Life Saving Service, it is essential to have rapid means of communication, as a delay of even a few minutes in rendering aid might result in the loss of lives and valuable vessels and cargo. The rescue of a ship's company imperiled on rocky shores or sandy shoals often depends upon the speedy arrival of a service cutter or the crew of a life saving station. A coastal telephone system, with over 2,200 miles of lines, supplies the needed communication. The Coast Guard stations, as well as 150 lighthouses, are supplied with telephone service. In addition, the Service has radio equipment on board its vessels and on shore. The Canadian Government reports a successful experiment in melting icebergs with thermit, a substance which quickly creates intense heat and acts upon ice somewhat as heat does upon glass.



Vessel in Distress—Cargo Shifted

THE WEATHER BUREAU

The United States Weather Bureau maintains about two hundred observation stations throughout the United States and the West Indies, each of which makes two regular reports daily. From the information thus gathered trained experts at the central office in Washington make forecasts of weather conditions that may be expected to prevail during the following thirty-six to forty-eight hours. From these data, compared with previous reports, the paths of storm areas, from the time of their appearance, may be determined and their probable courses predicted. Over a period of several years, about 90% of such forecasts proved correct.

Mexico, Canada and the chief countries of Europe and Asia maintain similar services and exchange daily reports with our government, thus covering nearly all of the northern hemisphere.

In addition to land observation stations, nearly two hundred vessels assist in gathering information in South Atlantic and Gulf waters and in the Caribbean Sea. This work is done for the purpose of learning about storms which have their origin in those waters. A similar service is maintained on the Pacific coast.

The United States Navy assists in distributing forecasts and warnings, by means of the radio. This service is of great importance to the mariner, as

forecasts are promptly sent to all stations along the coast and by radio to vessels upon the sea. When warned in advance of an approaching storm, ships are often able to avoid them by steaming into safe harbors or changing their courses. The Weather Bureau has recently announced the perfection of a system of sending maps and storm warnings by radio. By the use of this new system navigating officers at sea may know of map changes as soon as made and be in-

A Vessel in Distress

formed of approaching storms even when they are hundreds of miles away.

The service of observing and reporting storms has become so nearly perfect that for years scarcely a storm of marked danger to vessels has occurred of which ample warning has not been given from twelve to twenty-four hours in advance. The reports from the West Indies are especially valuable as they enable the Bureau to forecast with accuracy the approach of the destructive hurricanes originating there.

Storm warnings are displayed at more than three hundred points along our coasts and upon the Great Lakes. These warnings are of great value to vessel owners who, if they have a few hours' warning of a storm, are often able to load hurriedly and get away ahead of it. As the cost of operating a vessel is considerable, whether lying at the dock or moving, a day saved from idleness in the harbor means much saving to her owners.

Another form of service to shipping, performed by the Weather Bureau, is the reporting by name of vessels passing exposed and dangerous points. Thus their owners at home are assured as to their safety.

Still another aid is the reporting of floods and low water in streams and rivers. Observers are stationed along all of the important watercourses and accurate measurements of the water are made and records kept. At low water many boats are unable to dock, and advance information of low water conditions is therefore of great value.

High water caused by floods also makes the loading and unloading of cargoes difficult or impossible. By having advance notice of flood conditions vessel owners can prepare to meet them.

The Fog Warning

THE COAST AND GEODETIC SURVEY

As has been seen, it is extremely important that the navigator have charts and maps giving accurate information of all features of the waters where he is to cruise. He must know all about the shore line, rocks, sands, islands and reefs, as well as the tides and currents, in order to steer a safe course.

The importance of surveys to gain this information was early realized by our government and work was begun about a hundred years ago. Since that time a great quantity of valuable information has been accumulated and tens of thousands of charts, maps and tables made, which are available to mariners and those interested in shipping.

Much special equipment has been designed and many scientific instruments perfected for use in these surveys, greatly aiding the work and giving more accurate results.

One of the most interesting of these devices is the wire drag of which an illustration appears on the following page. This drag consists merely of a wire cable suspended in the water at a depth considered safe for all vessels. It is held in position by buoys attached at intervals and is drawn through the water by two boats, one at each end. With this wire sweep, as much as sixty-two square miles of territory has been covered in a single day. When the drag strikes rocks or other obstructions, such men-

aces to navigation are marked upon the charts and maps.

The work of the service in observing ocean currents has brought out some interesting facts, one of which is that local winds do not create currents in

Wire Drag—U. S. Coast and Geodetic Survey

the exact direction of the wind, but in a direction about 15° to the right of it. The currents set up by such winds represent about two per cent of the wind's velocity.

While the surveying of coast waters represents only a portion of the activities of the Coast and Geodetic Survey, such work bears more directly upon the subject of this volume. There is one other feature of the work, however, which is of great importance.

We have learned something about the compass and found that it pointed towards the magnetic north pole. Strange as it may seem, scientists have discovered that the magnetism of the earth is constantly changing, and that this has its effect upon the com-

pass. By making repeated observations with delicate instruments such variations may be noted on charts for the benefit of mariners. It has also been found that the compass is deflected more at some points than at others; this is thought to be due to deposits of magnetic iron ore in the earth at or near such points. All such information is charted as rapidly as it is secured.

Another interesting feature of the behavior of the compass is that, in some localities, the point dips considerably, more in some places than in others. When it is located directly above the magnetic pole the needle points directly downward.

Grace Darling and Her Father

Brooks

BRAVE GRACE DARLING

On November 24, 1814, in the quiet little village of Bamburgh, in Northumberland, England, there was born a little British girl whose name was destined to become famous the world around.

Grace Darling was the name of this little girl. And you have only to look in any library of English biography to find the story of her life. Although she lived only a quarter of a century, Grace Darling will always be remembered for her heroism. What did she do? She risked her own life to save others. More than that the greatest person in all the world's history could not do.

The story of Grace Darling's life and work is a most interesting one. She was the seventh child in the large family of William Darling, a lighthouse keeper. When Grace was very little her father succeeded her grandfather (Robert Darling) as keeper on the Brownsman, the outermost of the Farne Islands. In 1826 the family removed to the Longstone lighthouse, on another of the same group of islands. And it was here that Grace Darling, much to her surprise, became famous.

If you look on the map, you will find the Farne Islands just off the coast of Northumberland, England, a few miles south of the place where the Tweed river empties into the North Sea. This group of seventeen isles and rocks (some of which are visible only at low

tide) is a dreaded place for mariners. The passage between the islets is very dangerous in rough weather. Two of the islands have lighthouses. The one on which Grace Darling lived was about five miles from the mainland.

It was a very wild and desolate place in which to live. But Grace Darling loved her lighthouse home. She did not remember any other. The first sights and sounds that she recalled were those of the dancing sea, the barren rocks and the whistling wind. She learned to row and to swim at the same time that she learned to read and to write.

The lighthouse home was a happy one. Grace Darling's parents were true Christian people. The Bible was read, and prayers were daily offered at the family altar. Good music and good reading were the chief recreations. For weeks at a time in winter they saw no one. But in summer there were many visitors who came from the mainland to see the wonderful lighthouse, and talk with its keeper. Grace usually kept out of sight while visitors were there. She was very shy. Her brothers and sisters, one by one, left the lighthouse home to found homes of their own. But she preferred to stay with her father and mother. She helped her mother with the household tasks, and her father to care for the lights. She had never been called to help in the lifeboat, for some one else had usually been there when help was needed. But she was skilful with the oar. And though she was shy and not strong, she was not afraid of the sea.

It chanced that only her father, mother and herself were in the lighthouse on the night of September 5, 1838. A very strong wind was blowing, and Grace,

for some reason, could not sleep. Towards morning she thought she heard a cry. She listened. Yes, it was! Faintly above the roar of sea and wind she heard a cry of distress.

Grace rushed to the bedside of her father and wakened him from his sound sleep. Standing a few minutes later on the landing, she and her parents could clearly hear the calls, and through the early morning mist dim figures could be seen clinging to a wreck. Her father's stout heart faltered as he saw the raging sea. It seemed certain death to launch the boat.

But Grace would not delay. She forgot all the fearful risk in the thought that there were people out there on the rock who would surely die if not saved. She insisted on going, and seized an oar. Her father then jumped into the boat, too. Her mother, who had tearfully helped to launch the boat, called out as they pushed off into the boiling sea: "Oh, Grace, if your father is lost, I'll blame you always for this morning's work."

But Grace paid no attention now, though always obedient before. She had but one thought, that of rescuing the perishing. How she did it, she nor any one else ever knew. God only could tell. Somehow, the terrible sea was breasted by the united strength of father and daughter. Without the girl, the man could never have pulled the lifeboat alongside of the wreck. What a shout went up from the almost dead survivors! Only nine were left of the sixty, or more, who had sailed so gaily that morning from Hull on the steamship *"Forfarshire."* Two of them, sad to say, were little children who had died from exposure, in their mothers' arms.

Grace somehow managed to keep the boat beside the wreck. The return was made safely through the raging sea with the help of the men.

When a volunteer crew with great difficulty, came from Sunderland to the wreck, the work of rescue had been accomplished.

This daring act, so successfully carried out, filled every one with warmest admiration. Grace Darling found herself famous. The lighthouse at Longstone was visited by many of the wealthy and great. Presents, testimonials and money were heaped upon Grace. But she was not spoiled by popularity, although all this was enough to make any girl conceited and proud. She remained a hardworking, sensible girl to the close of her short life.

When she passed away in 1842, after a long illness from tuberculosis, many tributes were paid to her courage and kindness of heart. She lives today in the annals of fame as "the heroine of the Farne Islands."

Jane A. Stewart.

THE INCHCAPE ROCK

No stir in the air, no stir in the sea—
The ship was still as she could be;
Her sails from heaven received no motion;
Her keel was steady in the ocean.

Without either sign or sound of their shock,
The waves flowed over the Inchcape rock;
So little they rose, so little they fell,
They did not move the Inchcape bell.

The holy abbot of Aberbrothok
Had placed that bell on the Inchcape rock;
On a buoy in the storm it floated and swung,
And over the waves its warning rung.

When the rock was hid by the surges' swell,
The mariners heard the warning bell;
And then they knew the perilous rock,
And blessed the abbot of Aberbrothok.

The sun in heaven was shining gay,—
All things were joyful on that day;
The sea birds screamed as they wheeled around,
And there was joyance in their sound.

The buoy of the Inchcape bell was seen,
A darker speck on the ocean green;
Sir Ralph the Rover walked his deck,
And he fixed his eye on the darker speck.

He felt the cheering power of spring,—
It made him whistle, it made him sing;
His heart was mirthful to excess;
But the rover's mirth was wickedness.

His eye was on the Inchcape float;
Quoth he, "My men, put out the boat,
And row me to the Inchcape rock,
And I'll plague the abbot of Aberbrothok."

The boat is lowered, the boatmen row,
And to the Inchcape rock they go;
Sir Ralph bent over from the boat,
And cut the bell from the Inchcape float.

Down sank the bell with a gurgling sound;
The bubbles rose and burst around.
Quoth Sir Ralph, "The next who comes to the rock
Will not bless the abbot of Aberbrothok."

Sir Ralph the Rover sailed away,—
He scoured the seas for many a day;
And now, grown rich with plundered store,
He steers his course for Scotland's shore.

So thick a haze o'erspreads the sky
They can not see the sun on high;
The wind hath blown a gale all day;
At evening it hath died away.

On the deck the rover takes his stand;
So dark it is they see no land.
Quoth Sir Ralph, "It will be lighter soon,
For there is the dawn of the rising moon."

"Canst hear," said one, "the breakers roar?
For yonder, methinks, should be the shore.
Now where we are I can not tell,
But I wish we could hear the Inchcape bell."

They hear no sound; the swell is strong;
Though the wind hath fallen they drift along;
Till the vessel strikes with a shivering shock—
Alas! it is the Inchcape rock!

Sir Ralph the Rover tore his hair;
He cursed himself in his despair.
The waves rush in on every side;
The ship is sinking beneath the tide.

But even in his dying fear
One dreadful sound he seemed to hear—
A sound as if with the Inchcape bell
The Evil Spirit was ringing his knell.

Robert Southey.

A Shipwreck. From An Old Woodcut.

THE WHITE SQUALL

The sea was bright, and the bark rode well;
The breeze bore the tone of the vesper bell;
'T was a gallant bark with a crew as brave
As ever launched on the heaving wave.
She shone in the light of declining day,
And each sail was set, and each heart was gay.

They neared the land where in beauty smiles
The sunny shore of the Grecian Isles;
All thought of home, of that welcome dear
Which soon should greet each wanderer's ear;
And in fancy joined the social throng
In the festive dance and the joyous song.

A white cloud glides through the azure sky,—
What means that wild despairing cry?
Farewell the visioned scenes of home!
That cry is "Help," where no help can come;
For the White Squall rides on the surging wave,
And the bark is 'gulfed in an ocean grave.

Barry Cornwall.

BREAK, BREAK, BREAK.

Break, break, break,
  On thy cold, gray stones, O sea!
And I would that my tongue could utter
  The thoughts that arise in me.

Oh, well for the fisherman's boy
  That he shouts with his sister at play!
Oh, well for the sailor lad
  That he sings in his boat on the bay!

And the stately ships go on
  To the haven under the hill;
But oh, for the touch of a vanish'd hand,
  And the sound of a voice that is still!

Break, break, break,
  At the foot of thy crags, O sea!
But the tender grace of a day that is dead
  Will never come back to me.

Alfred Tennyson.

GLOSSARY

21 BINNACLE. A stand with case for holding the compass on shipboard. See illustration on page 21. If it is found that the metal of which the ship is made is affecting the compass, pieces of magnetized steel may be put in the binnacle case to compensate for such effect.

22 DEFLECTION. A turning from the usual or proper course.

23 LOCATING. Finding location or position.

26 CELESTIAL. Pertaining to the sky or visible heavens.

26 LUNAR DAY. The interval between moor-rise one day and moon-rise the next day.

27 SIGHT. Observation of heavenly bodies. See "Sextant," page 23.

28 SILT. Fine earth or mud carried by streams.

28 TERRESTRIAL. Belonging to the earth, especially the land of the earth's surface.

29 PILOTING. Directing a vessel's course.

30 HEAVING. Throwing.

30 BERTH. Reference here is to a place where a vessel docks or anchors.

31 CAST. To throw or let down the plummet.

34 CUTTER. A swift-going, armed government vessel.

38 CEDED. Transferred.

38 SHILLING. An English silver coin equal in value to 24 1-3 cents of United States money.

42 PROMETHEUS. A Titan who stole fire from heaven and gave it to man.

42 JOVE. Chief of the gods. He punished Prometheus for stealing the fire, by chaining him to a rock.

46 SIREN. A trumpet-like instrument for sounding warnings. See page 66.

47 ICE FLOES. In the spring great quantities of ice float down rivers into bays with such force as to carry a ship along with them.

49 HYDROGRAPHIC. Concerned with the making of maps and charts of the sea bottom and describing its characteristics.

50 BANK. A "bank" is a shoal, shelf or shallow in the sea bottom.

50 INSULAR. Of or pertaining to an island.

50 PLY. To go or travel to and fro.

51 GEODETIC. That part of surveying which determines the shape or curvature of the earth's surface. In marine practice, the surveying of the bottom of the sea.

54 RANGE. The distance at which the light may be seen.

56 RANGE LIGHTS. In this connection "range" means direction, or in line.

60 ACETYLENE. A gas generated by carbide when water is put on it.

67 PNEUMATICALLY. By air. Usually air is compressed by means of a pump, for operating machinery, as that gives it much force.

68 SUBMARINE. "Sub" means under and "marine" refers to the water. Under water.

70 LIST. To careen. Lean to one side.

70 VISIBILITY. By poor visibility is meant that weather conditions (rainy or foggy) were such that sailors could not see distinctly.

71 BEARING. Location in relation to other ships.

75 LEE. The side of the ship opposite the windward or side exposed to the wind.

77 DOCKING. Ships are put into drydock for repairing. A drydock is a basin connected with the harbor waters, shaped something like a ship's hull, into which a ship may be floated and which can then be closed and emptied so as to leave the vessel propped up on struts and blocks with the bottom dry and available for cleaning and repairs.

81 MAILED. Protected by armor.

89 BREECHES BUOY. A pair of canvass breeches attached to a life buoy and suspended from a rope or cable stretched between a distressed ship and a life-saving ship or the shore. Persons to be rescued sit in the breeches and are hauled to safety. See illustration on page 92.

89 ENSIGN. Flag. The flag is flown upside down, as a sign of distress.

90 HAWSER. A large rope for towing or fastening vessels. Hawsers are made as large as fifteen inches through. Draw a circle of that diameter to obtain an idea of the size of such an immense rope.

91 BOW. The forward part of a ship.

91 PORT. The left side of a vessel as you look towards the bow. The right side is called "starboard."

91 SHEERING. Changing from its course.

92 FLARES. Lights which burn quickly and brightly.

96 DIESEL. A powerful internal-combustion engine.

97 WEATHERING. Enduring. Coming through.

97 RUN. Put on board. Hawsers are too heavy to be handled readily by men, machinery usually being used to haul them on board.

98 MINE. An explosive bomb.

99 YAWED. Steered unevenly. Diverted from its course.

100 STERN. The rear end of a boat.

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